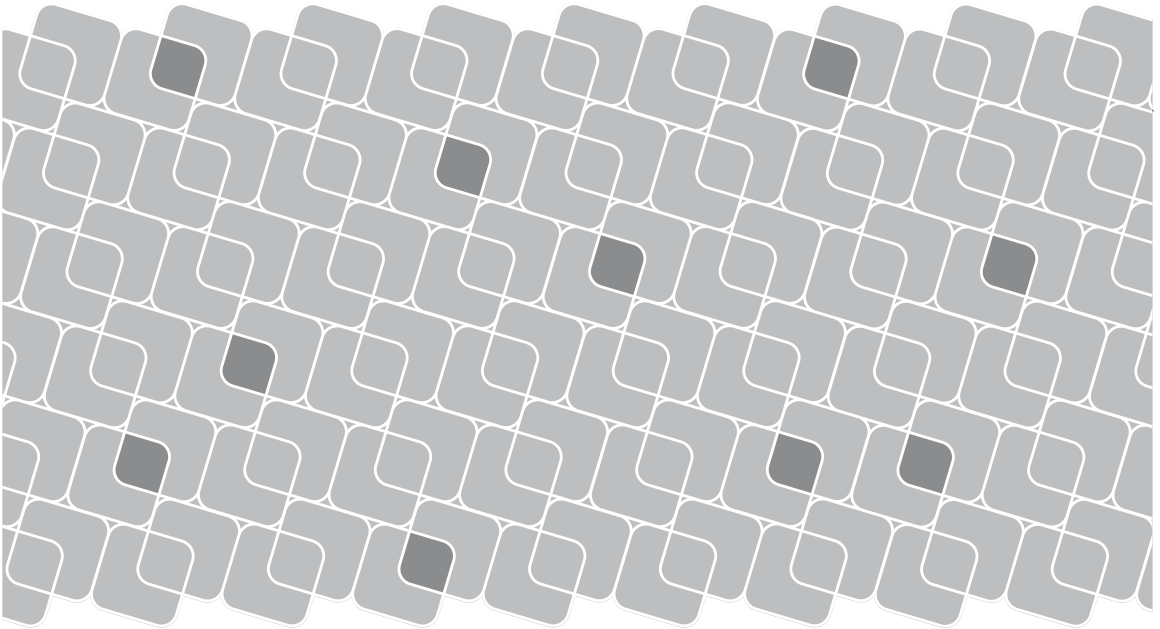
Workstation User's Manual

Workstation 6.0



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Preface

This preface provides information about the *Workstation User's Manual* and links to VMware® technical support and educational resources.

This preface contains the following topics:

- "About This Book" on page 15
- "Technical Support and Education Resources" on page 16

About This Book

This manual, the *Workstation User's Manual,* provides information about installing and using VMware Workstation 6.

To view the most current version of the manual, see the VMware Web site:

http://www.vmware.com/support/pubs/ws_pubs.html

Intended Audience

This book is intended for anyone who needs to install, upgrade, or use VMware Workstation. Workstation users typically include people who do software development and testing or work with multiple operating systems or computing environments: software developers, QA engineers, trainers, salespeople who run demos, and anyone who wants to create virtual machines.

Document Feedback

If you have comments about this documentation, submit your feedback to:

docfeedback@vmware.com

Conventions

The following typographic conventions are used in this manual.

Table P-1. Conventions Used in This Manual

Style	Elements
Blue boldface (online only)	Cross-references and links
Black boldface	User interface elements such as button names and menu items
`Monospace`	Commands, filenames, directories, and paths
`Monospace bold`	User input
Italic	Document titles, glossary terms, and occasional emphasis
< Name >	Variable and parameter names

Technical Support and Education Resources

The following sections describe the technical support resources available to you.

Self-Service Support

Use the VMware Technology Network (VMTN) for self-help tools and technical information:

- Product information – http://www.vmware.com/products/
- Technology information – http://www.vmware.com/vmtn/technology
- Documentation – http://www.vmware.com/support/pubs
- VMTN Knowledge Base – http://kb.vmware.com
- Discussion forums – http://www.vmware.com/community
- User groups – http://www.vmware.com/vmtn/usergroups.html

For more information about the VMware Technology Network, go to http://www.vmtn.net.

Online and Telephone Support

Use online support to submit technical support requests, view your product and contract information, and register your products. Go to http://www.vmware.com/support.

Customers with appropriate support contracts should use telephone support for the fastest response on priority 1 issues. Go to http://www.vmware.com/support/phone_support.html.

Support Offerings

Find out how VMware support offerings can help meet your business needs. Go to http://www.vmware.com/support/services.

Reporting Problems

If you have problems while running VMware Workstation, please report them to the VMware support team.

These guidelines describe the information the VMware support team needs from you to diagnose problems.

If a virtual machine exits abnormally or crashes, run the support script to collect the appropriate log files and system information. Follow the steps below that apply to your host computer.

To run the support script on a Windows host

1 Open a command prompt.

2 Change to the VMware Workstation program directory:

```
C:
cd \Program Files\VMware\VMware Workstation
```

If you did not install the program in the default directory, use the appropriate drive letter and path in the `cd` command above.

3 Run the support script:

```
cscript vm-support.vbs
```

After the script runs, it displays the name of the directory where it has stored its output.

4 Use a file compression utility such as WinZip or PKZIP to zip the script output directory, and include the zip file with your support request.

If you are reporting a problem you encountered while installing VMware Workstation, you should also include your installation log file.

On a Windows host, the file is `VMInst.log`. It is saved in your `Temp` folder. On a Windows 2000, Windows XP, or Windows Server 2003 host, the default location is `C:\Documents and Settings\<username>\Local Settings\Temp`.

You can use the command `cd %temp%` to locate the `Local Settings` folder, which is hidden by default. To see its contents, open **My Computer**, go to **Tools>Folder Options**, click the **View** tab and select **Show Hidden Files and Folders**.

To run the support script on a Linux host

1 Open a terminal window.

2 Run the support script as the user who is running the virtual machine:

```
vm-support
```

If you are not running the script as root, the script displays messages indicating that it cannot collect some information. This is normal. If the VMware support team needs that information, a support representative will ask you to run the script again as root.

The script creates a compressed `.tgz` file in the current directory.

3 Include that output file with your support request.

If you are reporting a problem you encountered while installing VMware Workstation, you should also include your installation log file.

Be sure to register your serial number. From the Workstation menu bar, choose **Help>VMware on the Web>Register Now!** You can then report your problems by submitting a support request at www.vmware.com/requestsupport.

VMware Education Services

VMware courses offer extensive hands-on labs, case study examples, and course materials designed to be used as on-the-job reference tools. For more information about VMware Education Services, go to http://mylearn1.vmware.com/mgrreg/index.cfm.

Introduction and System Requirements

1

This chapter provides an introduction to Workstation and describes the system requirements for operating Workstation. This chapter contains the following topics:

- "Product Benefits" on page 19
- "Overview of This Manual" on page 20
- "About the Host and Guest Computers" on page 21
- "What's New in Version 6" on page 21
- "Host System Requirements" on page 29
- "Virtual Machine Specifications" on page 35
- "Supported Guest Operating Systems" on page 38

Product Benefits

Workstation is desktop software that allows you to run multiple x86-compatible desktop and server operating systems simultaneously on a single PC, in fully networked, portable virtual machines—with no rebooting or hard drive partitioning required.

With Workstation, you spend less time procuring and configuring, and more time testing, deploying, teaching, or running demos. Over three million software development, quality assurance, training, sales, and IT professionals worldwide find Workstation an indispensable tool.

To streamline software development and testing:

- Develop and test multiple operating systems and applications on a single PC.
- Connect virtual machines to simulate and test multitier configurations.

- Use multiple snapshots and debugging support to facilitate testing.
- Archive test environments on file servers where they can be easily restored or shared.

To enhance productivity of IT professionals:

- Configure and test desktops and servers as virtual machines before deploying them to production.
- Test new multitier applications, application updates, and OS patches on a single PC.
- Host legacy applications within virtual machines, facilitating OS migrations and eliminating the need to port legacy applications.
- Create a virtual library of end-user configurations on a shared drive.

To facilitate computer-based training and software demos:

- Package and deploy classroom material in virtual machines.
- Allow students to experiment with multiple operating systems, applications, and tools in secure, isolated virtual machines.
- Configure virtual machines to undo all changes at shutdown.
- Demo complex or multitier configurations on a single laptop.

Overview of This Manual

If you're a veteran user of VMware products, see "What's New in Version 6" on page 21 and see Chapter 3, "Upgrading VMware Workstation," on page 55.

If you're new to VMware Workstation, the first chapters of this manual—through Chapter 7, "Running a Virtual Machine," on page 147—introduce you to some of the things you can do with VMware Workstation and guide you through the key steps for installing the software and putting it to work.

Later chapters provide in-depth reference material for getting the most out of the sophisticated features of Workstation.

About the Host and Guest Computers

The terms *host* and *guest* describe your physical and virtual machines:

- The physical computer on which you install the VMware Workstation software is called the *host computer*, and its operating system is called the *host operating system*.
- The operating system running inside a virtual machine is called a *guest operating system*.

For definitions of these and other special terms, see "Glossary" on page 441.

What's New in Version 6

The sections that follow describe the features that have been added to the Workstation 6.0 release.

Upgrade Path to Workstation ACE Edition

VMware ACE 2.0 is a solution for deploying *assured computing environments* and securing remote desktops. VMware ACE Virtual Rights Management (VRM) centralizes management of security policies and access rights applied to virtual machines. ACE is used primarily to ensure more secure guest worker, partner, and remote PC access.

Adding ACE capabilities into Workstation ACE Edition means that ACE administrators can now take multiple snapshots, create linked and full clones, and so on. These Workstation features will allow desktop security administrators to easily test patches and new applications before deploying virtual machines to end-user PCs.

The VRM capabilities of ACE, such as expiration and encryption, are important for Workstation users who want to create virtual appliances. Expiration capabilities enable ISVs to easily distribute evaluation copies of virtual appliances.

If you purchase a license for the ACE functionality, you will see, in addition to Workstation window elements, ACE-specific menu items, toolbar buttons, and other interface elements. These elements enable you to write security policies that control encryption, authentication, expiration, copy protection, network access, and device access for the virtual machine. You can then create MSI-compliant deployment packages that include these policies along with the virtual machine.

Documentation for the ACE functionality is provided in the *VMware ACE Administrator's Manual*, available from the VMware web site at:

http://www.vmware.com/support/pubs/ace_pubs.html

Integrated Virtual Debuggers

With the new Workstation IDE (integrated development environment) plug-ins, software developers are provided with a configurable interface between their virtual machines and Visual Studio (Windows only) or Eclipse (Windows or Linux) that lets them easily test, run, and debug programs in virtual machines.

You can specify settings such as the location of the virtual machine, which setup or clean-up scripts to execute, the location of shared folders, and (in Visual Studio) directories to be copied between the host and guest.

When configured, the integrated virtual debugger finds the virtual machine, powers it on if necessary, sets up the environment based on your configuration settings, and launches or attaches to the application. All breakpoints, watch points, and so on that you set in your IDE will function as if you were running your application on the host computer.

Depending on the configuration setting you specify, when the application finishes running, the virtual machine is powered off, suspended, reverted to a snapshot, or left in its current state.

For information about using the Workstation IDE plug-ins, see Appendix B, "Using the Eclipse Integrated Virtual Debugger," on page 411 and Appendix C, "Using the Visual Studio Integrated Virtual Debugger," on page 423.

VMware Player 2.0

When you install Workstation, VMware Player 2.0 is also installed. This new version of Player provides a user-friendly Welcome page that gives you the option of browsing to a virtual machine file, downloading a virtual appliance from the VMTN (VMware Technology Network) web site, or opening a recently used virtual machine. If you download an appliance, you can then use Player's new appliance view when running a virtual appliance.

Player 2.0 also enables you to share folders between the host and guest operating systems.

For more information about the "built-in" VMware Player, see "Sharing Virtual Machines with VMware Player" on page 192.

Automation Through Expanded VIX 1.1 API

The VIX API (formerly known as the Programming API) allows you to write scripts and programs to automate virtual machine operations. The API is high-level, easy to use, and practical for both script writers and application programmers.

This release of the API is available in the C language. API functions allow you to register, power on or off virtual machines, and run programs in the guest operating systems. There are additional language bindings for Perl, COM, and shell scripts (`vmrun`). For more information, see the VMware VIX API 1.1 Release Notes.

Record/Replay of Virtual Machine Activity (Experimental)

This feature lets you record all of a Workstation 5 or 6 virtual machine's activity over a period of time. Unlike Workstation's movie-capture feature, the record/replay feature lets you exactly duplicate the operations and state of the virtual machine throughout the time of the recording. See "Recording Activity of a Virtual Machine (Experimental)" on page 237.

Physical-to-Virtual Conversion and Enhanced Import Functionality (Windows Hosts Only)

Workstation 6.0 incorporates the Importer wizard from the VMware Converter product. Using the Converter Import wizard enables you to convert a physical Windows machine into a virtual machine and convert a virtual machine from one VMware virtual machine format to another. You can also convert virtual machines or system images from the following third-party vendors into a VMware virtual machine:

- StorageCraft images (`.spf` files)
- Microsoft Virtual PC 7.x and higher (`.vmc` files)
- Any version of Microsoft Virtual Server (`.vmc` files)
- Symantec Backup Exec System Recovery—formerly LiveState Recovery (`.sv2i` files)
- Norton Ghost images 9.x and higher (`.sv2i` files)

For more information, see "Importing Virtual Machines from Other Formats (Windows Hosts Only)" on page 98.

Easy Upgrade or Downgrade of VMware Virtual Machines

A new Change Version wizard steps you through the process of upgrading or downgrading virtual machines between Workstation versions 4, 5, and 6.

The wizard helps you determine which virtual hardware version to use for various VMware products. You have the choice of either changing the version of the original virtual machine or creating a full clone. For more information, see "Changing the Version of the Virtual Machine" on page 59.

Running Virtual Machines in the Background

You no longer need to power off virtual machines when you exit Workstation. You can leave virtual machines running in the background, even when Workstation is not running. On the host, an icon in the notification area of the taskbar indicates how many virtual machines are running in the background. Click the icon to display a list of the powered-on virtual machines. See "Closing Virtual Machines and Exiting Workstation" on page 84.

You can then interact with virtual machines outside of Workstation by using a VNC (virtual network computing) connection. See "Using a VNC Client for Remote Connections to a Virtual Machine" on page 182.

You can also launch a virtual machine in the background by using the VMware Programming API (known as "VIX"), and later connect to the powered-on virtual machine with Workstation.

Support for Multiple-Monitor Displays

You can specify how many monitors a virtual machine can detect, regardless of how many monitors are attached to the host. This feature is especially useful if you plan to deploy the virtual machine to a different host after you create it.

You can also specify which screen resolution to use. For more information, see "Using Multiple Monitors" on page 160.

Increase in Number of Ethernet Adapters Supported

You can now have a total of 10 Ethernet adapters for a virtual machine.

New 64-Bit Sound Driver

VMware Tools installs a sound driver in 64-bit Windows guest operating systems. Newly created 64-bit Windows virtual machines are now configured with audio hardware by default. See "Sound" on page 37.

Support for High-Speed USB 2.0 Devices

If the guest operating system has appropriate USB 2.0 device drivers, you can use peripherals that require high-speed performance, such as speakers, webcams, next-generation printers and scanners, fast storage devices, MP3 players, DVD-RW drives, and high-capacity CD-ROM jukeboxes. You can connect to six USB 2.0 devices. See "Using USB Devices in a Virtual Machine" on page 351.

For USB 1.1 devices, a virtual USB hub has been added so that you can connect to more than two USB 1.1 devices.

Ability for a Virtual Machine to Act as a VNC Server

VNC (Virtual Network Computing) software makes it possible to view and interact with a computer from any remote computer or mobile device connected to the Internet. You can set a virtual machine to act as a VNC server without installing any third-party VNC software in the guest. Users on remote computers can install a VNC client (also called a VNC viewer) to connect to the virtual machine and interact with it. See "Using a VNC Client for Remote Connections to a Virtual Machine" on page 182.

Increased RAM Support and Ability to Run on Server-Class Systems

The previous limit of 4GB total RAM that could be used for all virtual machines combined has been removed. As of this release, the amount of memory used by all virtual machines combined is limited only by the amount of the host computer's RAM. The maximum amount of memory that can be allocated per virtual machine has been raised from 4GB to 8GB.

You can also install Workstation on server-class hardware and host operating systems.

New Host Operating System Support

The following 32-bit hosts are supported:

- Windows Vista Enterprise
- Windows Vista Business
- Windows Vista Home Basic and Premium
- Windows Vista Ultimate
- Red Hat Enterprise Linux 4.5 (Beta, formerly called 4.0 Update 5)
- Red Hat Enterprise Linux 5.0
- SUSE Linux Enterprise Server 9 SP4 (Beta)
- openSUSE 10.2 (formerly known as SUSE Linux 10.2)
- Ubuntu Linux 6.10
- Mandriva Linux 2007
- Mandriva Corporate Desktop 4.0

The following 64-bit hosts are supported:

- Windows Vista Enterprise
- Windows Vista Business
- Windows Vista Home Basic and Premium
- Windows Vista Ultimate
- Red Hat Enterprise Linux 4.5 (Beta, formerly called 4.0 Update 5)
- Red Hat Enterprise Linux 5.0
- SUSE Linux Enterprise Server 9 SP4 (Beta)
- openSUSE 10.2 (formerly known as SUSE Linux 10.2)
- Ubuntu Linux 6.10
- Mandriva Linux 2007
- Mandriva Corporate Desktop 4.0

New Guest Operating System Support

The following 32-bit guests are supported:

- Windows Vista Enterprise (3-D effects not yet supported)
- Windows Vista Business (3-D effects not yet supported)
- Windows Vista Home Basic and Premium (3-D effects not yet supported)
- Windows Vista Ultimate (3-D effects not yet supported)
- Red Hat Enterprise Linux 4.5 (Beta)
- Red Hat Enterprise Linux 5.0
- SUSE Linux Enterprise Server 9 SP4 (Beta)
- openSUSE 10.2 (formerly known as SUSE Linux 10.2)
- Solaris 10 Update 3
- Novell Netware 6.5 SP5
- Ubuntu Linux 6.10
- Ubuntu Linux 7.04 (Beta)
- Mandriva Linux 2007
- Mandriva Corporate Desktop 4.0

The following 64-bit guests are supported:

- Windows Vista Enterprise (3-D effects not yet supported)
- Windows Vista Business (3-D effects not yet supported)
- Windows Vista Home Basic and Premium (3-D effects not yet supported)
- Windows Vista Ultimate (3-D effects not yet supported)

- Red Hat Enterprise Linux 4.5 (Beta)
- Red Hat Enterprise Linux 5.0
- SUSE Linux Enterprise Server 9 SP4 (Beta)
- openSUSE 10.2 (formerly known as SUSE Linux 10.2)
- Solaris x86 10 Update 3
- Ubuntu Linux 6.10
- Ubuntu Linux 7.04 (Beta)
- Mandriva Linux 2007
- Mandriva Corporate Desktop 4.0

Improved 64-Bit Guest Support

64-bit guest operating systems that run on Intel EM64T VT-capable processors are fully supported.

Appliance View for Virtual Appliances

If you set up a virtual machine to act as an "appliance," such as a Web server with a browser-based interface, specify the default view as the new appliance view, rather than the operating system console. The appliance view gives you a brief description of the type of server or appliance and provides a link that opens a browser on the host system and connects to appliance's management console. The appliance view is available for Workstation 6 virtual machines. See "Displaying the Virtual Machine as an Appliance" on page 168.

Monitor the Status of a Battery from the Guest Operating System

If you are running a virtual machine on a laptop, you can configure the virtual machine to monitor the state of the host's physical battery. If your guest operating system is configured to respond to low-battery situations, it can do so effectively. See "Reporting Battery Information in the Guest Operating System" on page 158.

Enhanced Ability to Gather Debugging Information

You no longer need to power off or suspend a virtual machine before setting it to generate debugging information. In addition, a new mode has been added that allows extensive statistics to be gathered about the virtual machine. These statistics are often valuable in determining why a virtual machine runs slowly under some workloads. See "Turning Off Debugging Mode" on page 378.

Support for Paravirtualized Linux Kernels

If you have a VMware VMI (Virtual Machine Interface) 3.0 enabled kernel in a Linux guest operating system, you can enable paravirtual support in the virtual machine. This support results in improved performance. See "Enhanced Performance with Paravirtualized Kernels in Linux Guests" on page 384.

User Interface for Mapping a Virtual Disk to a Drive Letter

Workstation menu commands are available to enable you to use a mapped drive to connect to a virtual disk without having to go into a virtual machine. Previously, this functionality was available only by using a command-line utility. Alternatively, you can map a drive by right-clicking a virtual disk (`.vmdk`) file in Windows Explorer. This feature gives you another way of transferring files between host and guests. See "Using a Mapped Drive (Windows Only)" on page 178.

Automatic Update to the Latest Version of VMware Tools

Every time you power on a virtual machine, the guest operating system compares its version of VMware Tools against the version that is currently installed on the host. If an update is available, you see a message in the status bar of the window. To upgrade to the new version, you previously needed to use a menu item to install the new version.

With Workstation 6, on Windows and Linux guests, you have the option of setting VMware Tools to automatically upgrade itself when the virtual machine is powered on. On Windows hosts, if you don't choose to automatically upgrade, you can alternatively right-click the **Tools** icon in the notification area of the guest's taskbar to open the VMware Tools Control Panel and click the **Upgrade** button. See "Upgrading VMware Tools" on page 114.

Enhanced Ability to Restrict Shared Folders

As a security precaution, a feature has been added that disables shared folders for virtual machines that you download or copy from another location. This change protects you from powering on a malicious virtual machine that might use shared folders to gain access to data on your host machine. You can, however, change this default behavior.

If you have a previous version of Workstation and you used shared folders, you will find, after upgrading to Workstation 6.0, that you will need to re-enable folder sharing. You have various levels of security when sharing folders:

- Enable some or all shared folders for a particular virtual machine.
- Set shared folders to be disabled at the next power-on.

- Set a default to enable all shared folders that might be present in virtual machines that you did not create yourself.

See "Using Shared Folders" on page 171.

VMware Player 2.0 now allows you to use shared folders. See "Sharing Virtual Machines with VMware Player" on page 192.

Enhanced File Sharing and Copy and Paste Functionality

Following is a list of enhancements for the Workstation 6.0 release:

- Use shared folders on a Solaris guest. (Previously, shared folders were available only for Linux and Windows guests.) See "Using Shared Folders" on page 171.
- Drag and drop files between a Linux or Windows host and a Linux, Windows, or Solaris guest. (Linux hosts and Linux and Solaris guests must be running X Windows.) See "Using Drag and Drop" on page 169.
- Copy and paste text between a Windows or Linux host and a Windows, Linux, or Solaris guest. See "Using Copy and Paste" on page 170.
- Copy and paste files, not just text, between a Windows or Linux host and a Windows, Linux, or Solaris guest. See "Using Copy and Paste" on page 170.
- On Linux hosts and guests, many improvements have been made to performance, permissions handling, and share mounting, as described in "Shared Folders on Linux Guests: Permissions and Folder Mounting" on page 176.

Host System Requirements

Like physical computers, the virtual machines running under Workstation perform better if they have faster processors and more memory.

PC Hardware

- Standard x86-compatible or x86-64-compatible personal computer
- 733MHz or faster CPU minimum

  Compatible processors include:

  - Intel: Celeron, Pentium II, Pentium III, Pentium 4, Pentium M (including computers with Centrino mobile technology), Xeon (including "Prestonia"), and Core 2 processors

- AMD: Athlon, Athlon MP, Athlon XP, Athlon 64, Duron, Opteron, Turion 64
- AMD Sempron

For additional information, including notes on processors that are not compatible, see the VMware knowledge base at www.vmware.com/support/kb/enduser/std_adp.php?p_faqid=967.

- Multiprocessor systems supported
- 64-bit systems supported: AMD Opteron, AMD Athlon 64, AMD Turion 64, AMD Sempron, Intel EM64T. Support for 64-bit guest operating systems is available only on the following versions of these processors:
  - AMD Athlon 64, revision D or later
  - AMD Opteron, revision E or later
  - AMD Turion 64, revision E or later
  - AMD Sempron, 64-bit-capable revision D or later
  - Intel Pentium 4 and Core 2 processors with EM64T and Intel Virtualization Technology

Memory

512MB minimum (2GB is recommended).

You must have enough memory to run the host operating system, plus the memory required for each guest operating system and for applications on the host and guest. See your guest operating system and application documentation for their memory requirements.

As of version 6.0 of Workstation, the total amount of memory you can assign to all virtual machines running on a single host is unlimited. The maximum amount of memory per virtual machine is 8GB.

Display

16-bit or 32-bit display adapter is recommended.

Disk Drives

Guest operating systems can reside on physical disk partitions or in virtual disk files.

Hard Disk

- IDE and SCSI hard drives supported.
- At least 1GB free disk space recommended for each guest operating system and the application software used with it. If you use a default setup, the actual disk space needs are approximately the same as those for installing and running the guest operating system and applications on a physical computer.
- **For installation** – 200MB (Linux) or 650MB (Windows) free disk space required for basic installation. You can delete the installer afterwards to reclaim disk space.

Optical CD-ROM/DVD-ROM Drive

- IDE and SCSI optical drives supported.
- CD-ROM and DVD-ROM drives supported.
- ISO disk image files supported.

Floppy Drives

Virtual machines can connect to the host's floppy drives. Floppy disk image files are also supported.

Local Area Networking (Optional)

- Any Ethernet controller supported by the host operating system.
- Non-Ethernet networks supported using built-in network address translation (NAT) or using a combination of host-only networking plus routing software on the host operating system.

Host Operating System

VMware Workstation is available for both Windows and Linux host operating systems.

Windows Host Operating Systems (32-Bit)

Workstation supports the following Windows 32-bit host operating systems:

- Windows Vista Enterprise Edition
  Windows Vista Business Edition
  Windows Vista Home Basic and Premium Editions
  Windows Vista Ultimate Edition
- Windows Server 2003 Standard Edition, SP1
  Windows Server 2003 Web Edition, SP1

Windows Server 2003 Small Business Edition, SP1
Windows Server 2003 Enterprise Edition, SP1
Windows Server 2003 R2
(Listed versions are also supported with no service pack.)

- Windows XP Home Edition, SP1, SP2
  Windows XP Professional, SP1, SP2
  (Listed versions are also supported with no service pack.)
- Windows 2000 Server SP3, SP4
  Windows 2000 Professional, SP3, SP4
  Windows 2000 Advanced Server, SP3, SP4

Windows Host Operating Systems (64-Bit)

- Windows Vista Enterprise Edition
  Windows Vista Business Edition
  Windows Vista Home Basic and Premium Editions
  Windows Vista Ultimate Edition
- Windows Server 2003 x64 Edition SP1
  Windows Server 2003 x64 Edition R2
- Windows XP Professional x64 Edition

A Web browser is required for the Help system.

Linux Host Operating Systems (32-Bit)

Supported distributions and kernels are listed below. Workstation might not run on systems that do not meet these requirements.

NOTE As newer Linux kernels and distributions are released, VMware modifies and tests its products for stability and reliability on those host platforms. VMware makes every effort to add support for new kernels and distributions in a timely manner, but until a kernel or distribution is added to the list below, its use with VMware products is not supported. Look for newer prebuilt modules in the download area of the VMware Web site. Go to www.vmware.com/download/.

- Mandriva Linux 2006 and 2007
  Mandriva Corporate Desktop 4.0
  Mandriva Corporate Server 4.0
  Mandrake Linux 10.1
  Mandrake Linux 9.0 — stock 2.4.19

- Red Hat Enterprise Linux 5.0

  Red Hat Enterprise Linux WS 4.5 (Beta, formerly called 4.0 Update 5)
  Red Hat Enterprise Linux AS 4.0, updates 1, 2, 3, 4
  Red Hat Enterprise Linux ES 4.0, updates 1, 2, 3, 4
  Red Hat Enterprise Linux WS 4.0, updates 1, 2, 3, 4

  Red Hat Enterprise Linux AS 3.0, updates 1, 2, 3, 4, 5, 6, 7, 8
  Red Hat Enterprise Linux ES 3.0, updates 1, 2, 3, 4, 5, 6, 7, 8
  Red Hat Enterprise Linux WS 3.0, updates 1, 2, 3, 4, 5, 6, 7, 8

  Red Hat Enterprise Linux 2.1 — stock 2.4.9-e3

  Red Hat Linux 9.0 — stock 2.4.20-8, upgrade 2.4.20-20.9
  Red Hat Linux 8.0 — stock 2.4.18
  Red Hat Linux 7.3 — stock 2.4.18
  Red Hat Linux 7.2 — stock 2.4.7-10, upgrade 2.4.9-7, upgrade 2.4.9-13, upgrade 2.4.9-21, upgrade 2.4.9-31
  Red Hat Linux 7.1 — stock 2.4.2-2, upgrade 2.4.3-12
  Red Hat Linux 7.0 — stock 2.2.16-22, upgrade 2.2.17-14

- SUSE Linux Enterprise Server 10
  SUSE Linux Enterprise Server 9 SP4 (Beta)
  SUSE Linux Enterprise Server 9, 9 SP1, 9 SP2, 9 SP3
  (Listed versions are also supported with no service pack.)
  SUSE Linux Enterprise Server 8, stock 2.4.19

  openSUSE 10.2 (formerly known as SUSE Linux 10.2)
  SUSE Linux 10.1
  SUSE Linux 10
  SUSE Linux 9.3
  SUSE Linux 9.2, SP1)
  SUSE Linux 9.1 — stock 2.6.4-52
  SUSE Linux 9.0 — stock 2.4.21-99
  SUSE Linux 8.2 — stock 2.4.20

- Ubuntu Linux 6.10
  Ubuntu Linux 6.06
  Ubuntu Linux 5.10
  Ubuntu Linux 5.04

A Web browser is required for the Help system.

Linux Host Operating Systems (64-Bit)

Supported distributions and kernels are listed below. Workstation might not run on systems that do not meet these requirements.

NOTE As newer Linux kernels and distributions are released, VMware modifies and tests its products for stability and reliability on those host platforms. VMware makes every effort to add support for new kernels and distributions in a timely manner, but until a kernel or distribution is added to the list below, its use with VMware products is not supported. Look for newer prebuilt modules in the download area of the VMware Web site. Go to www.vmware.com/download/.

- Mandriva Linux 2006 and 2007
  Mandriva Corporate Desktop 4.0
  Mandriva Corporate Server 4.0

  Important: On 64-bit Mandriva hosts, some 32-bit compatibility libraries are required. Specifically, 32-bit `glibc`, `X11`, and `libXtst.so` are required.

- Red Hat Enterprise Linux 5.0

  Red Hat Enterprise Linux 4.5 (Beta, formerly called 4.0 Update 5)
  Red Hat Enterprise Linux AS 4.0, updates 3, 4
  Red Hat Enterprise Linux ES 4.0, updates 3, 4
  Red Hat Enterprise Linux WS 4.0, updates 3, 4

  Red Hat Enterprise Linux AS 3.0, stock 2.4.21, updates 2.4.21-15, 6, 7, 8
  Red Hat Enterprise Linux ES 3.0, stock 2.4.21, updates 2.4.21-15, 6, 7, 8
  Red Hat Enterprise Linux WS 3.0, stock 2.4.21, updates 2.4.21-15, 6, 7, 8

- SUSE Linux Enterprise Server 10
  SUSE Linux Enterprise Server 9 SP4 (Beta)
  SUSE Linux Enterprise Server 9, SP1, SP2, SP3
  (Listed versions are also supported with no service pack.)

  openSUSE 10.2 (formerly known as SUSE Linux 10.2)
  SUSE Linux 10.1
  SUSE Linux 10
  SUSE Linux 9.3
  SUSE Linux 9.2, SP1
  SUSE Linux 9.1 — stock 2.6.4-52

- Ubuntu Linux 6.10
  Ubuntu Linux 6.06
  Ubuntu Linux 5.10
  Ubuntu Linux 5.04

  Important: On 64-bit Ubuntu 6.x hosts, some 32-bit compatibility libraries are required. Specifically, 32-bit `glibc` and `X11` are required.

See the *VMware Guest Operating System Installation Guide* for version details about these operating systems. A Web browser is required for the Help system.

Virtual Machine Specifications

The following sections describe the devices supported by Workstation virtual machines.

Processor

- Same processor as that on host computer.
- One virtual processor on a host with one or more logical processors.
- Two virtual processors (two-way virtual symmetric multiprocessing, or Virtual SMP) on a host with at least two logical processors.

  The following are all considered to have two logical processors:

  - A multiprocessor host with two or more physical CPUs
  - A single-processor host with a multicore CPU
  - A single-processor host with hyperthreading enabled

  See "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 365.

Chip Set

- Intel 440BX-based motherboard
- NS338 SIO
- 82093AA IOAPIC

BIOS

PhoenixBIOS 4.0 Release 6 with VESA BIOS

Memory

- Up to 8GB, depending on host memory.
- No maximum limit for the total available for all virtual machines.

Graphics

VGA and SVGA support

IDE Drives

- Up to four devices—disks, CD-ROM or DVD-ROM (DVD drives can be used to read data DVD-ROM discs; DVD video is not supported).
- Hard disks can be virtual disks or physical disks.
- IDE virtual disks up to 950GB.
- CD-ROM can be a physical device or an ISO image file.

SCSI Devices

- Up to 60 devices.
- SCSI virtual disks up to 950GB.
- Hard disks can be virtual disks or physical disks.
- Generic SCSI support allows devices to be used without need for drivers in the host operating system. Works with scanners, CD-ROM, DVD-ROM, tape drives and other SCSI devices.
- LSI Logic LSI53C10xx Ultra320 SCSI I/O controller.
- Mylex (BusLogic) BT-958 compatible host bus adapter (requires add-on driver from VMware for Windows XP and Windows Server 2003).

Floppy Drives

- Up to two 1.44MB floppy devices.
- Physical drives or floppy image files.

Serial (COM) Ports

- Up to four serial (COM) ports.
- Output to serial ports, Windows or Linux files, or named pipes.

Parallel (LPT) Ports

- Up to three bidirectional parallel (LPT) ports.
- Output to parallel ports or host operating system files.

USB ports

- USB 1.1 UHCI controller, with a (transparent) virtual hub so that more than two devices can be connected.
- USB 2.0 EHCI controller that supports up to six devices. (You need use the virtual machine settings editor to enable USB 2.0 support. See "Enabling and Disabling the USB 2.0 Controller" on page 352.)
- Supports most devices, including USB printers, scanners, PDAs, hard disk drives, memory card readers and digital cameras, as well as streaming devices such as webcams, speakers, and microphones.

Keyboard

104-key Windows 95/98 enhanced

Mouse and Drawing Tablets

- PS/2 mouse
- Serial tablets supported

Ethernet Card

- Up to 10 virtual Ethernet cards.
- AMD PCnet-PCI II compatible.
- For 64-bit guests: Intel Pro/1000 MT Server Adapter compatible.

Sound

- Sound output and input.
- Emulates Creative Labs Sound Blaster AudioPCI. (MIDI input, game controllers and joysticks are not supported, except for USB devices.)

Virtual Networking

- Support for 10 virtual Ethernet switches on Microsoft Windows host operating systems. Support for 100 virtual Ethernet switches on Linux hosts. Three switches are configured by default for bridged, host-only, and NAT networking.
- Support for most Ethernet-based protocols, including TCP/IP, NetBEUI, Microsoft Networking, Samba, Novell Netware, and Network File System.
- Built-in NAT supports client software using TCP/IP, FTP, DNS, HTTP, and Telnet, including VPN support for PPTP over NAT.

Supported Guest Operating Systems

This section provides a simplified list of guest operating systems supported for virtual machines running in VMware Workstation. For the most recent list of supported guest operating systems, including detailed information about the specific operating system versions, service packs, and updates supported, see the *VMware Guest Operating System Installation Guide*, at http://pubs.vmware.com/guestnotes/. This guide also provides notes on installing the most common guest operating systems.

Operating systems that are not listed are not supported for use in a Workstation virtual machine.

Microsoft Windows 32-Bit

- Windows Vista (3-D effects not yet supported)
- Windows Server 2003, Small Business Server 2003
  Windows Server 2003 Web Edition
- Windows XP Professional and Home Edition
- Windows 2000 Professional
  Windows 2000 Server
  Windows 2000 Advanced Server
- Windows NT Workstation and Server 4.0
  Windows NT 4.0 Terminal Server Edition
- Windows Me
- Windows 98
- Windows 95
- Windows for Workgroups
- Windows 3.1

See the *VMware Guest Operating System Installation Guide* for service pack and version details about these operating systems.

Microsoft Windows 64-Bit

- Windows Vista x64 Edition (3-D effects not yet supported)
- Windows Server 2003 x64 Edition
- Windows XP Professional x64

See the *VMware Guest Operating System Installation Guide* for service pack and version details about these operating systems, at http://pubs.vmware.com/guestnotes/.

Microsoft MS-DOS

MS-DOS

Linux 32-Bit

- Mandriva Linux 2006 and 2007
- Mandrake Linux
- Red Hat Linux
- Red Hat Enterprise Linux Advanced Server, Enterprise Server, and Workstation
- SUSE Linux
- SUSE Linux Enterprise Server
- Turbolinux Server, Enterprise Server, Workstation, Desktop
- Novell Linux Desktop
- Sun Java Desktop System (JDS)
- Ubuntu Linux

See the *VMware Guest Operating System Installation Guide* for version details about these operating systems, at http://pubs.vmware.com/guestnotes/.

Linux 64-Bit

- Mandriva Linux 2006 and 2007
- Red Hat Enterprise Linux Advanced Server, Enterprise Server, and Workstation
- SUSE Linux Enterprise Server

- SUSE Linux
- Ubuntu Linux

See the *VMware Guest Operating System Installation Guide* for version details about these operating systems, at http://pubs.vmware.com/guestnotes/.

Novell NetWare 32-Bit

NetWare

See the *VMware Guest Operating System Installation Guide* for version details about this operating system, at http://pubs.vmware.com/guestnotes/.

Novell Open Enterprise Server 32-Bit

Open Enterprise Server 32-bit

See the *VMware Guest Operating System Installation Guide* for version details about this operating system, at http://pubs.vmware.com/guestnotes/.

FreeBSD 32-Bit

FreeBSD 32-bit

If you use SCSI virtual disks larger than 2GB with FreeBSD 4.0–4.3, there are known problems, and the guest operating system does not boot. To work around this issue, see the *VMware Guest Operating System Installation Guide*, at http://pubs.vmware.com/guestnotes/.

FreeBSD 64-Bit

FreeBSD 64-bit

See the *VMware Guest Operating System Installation Guide* for version details about this operating system, at http://pubs.vmware.com/guestnotes/.

Sun Solaris 32-Bit

Solaris x86 32-bit

Sun Solaris 64-Bit

Solaris x86 64-bit

Support for 64-Bit Guest Operating Systems

Workstation supports virtual machines with 64-bit guest operating systems, running on host machines with the following processors:

- AMD Athlon 64, revision D or later
- AMD Opteron, revision E or later
- AMD Turion 64, revision E or later
- AMD Sempron, 64-bit-capable revision D or later
- Intel EM64T VT-capable processors

Workstation supports virtual machines with 64-bit guest operating systems only on host machines that have one of the supported 64-bit processors. When you power on a virtual machine with a 64-bit guest operating system, Workstation performs an internal check: if the host CPU is not a supported 64-bit processor, you cannot power on the virtual machine.

VMware also provides a standalone utility that you can use without Workstation to perform the same check and determine whether your CPU is supported for Workstation virtual machines with 64-bit guest operating systems. You can download the 64-bit processor check utility from www.vmware.com/download.

Workstation supports virtual machines with 64-bit guest operating systems only in versions 5.5 and later. If your version of Workstation is 5.0 or earlier, upgrade to version 5.5 or later for 64-bit guest operating system support. A virtual machine created in Workstation version 5.5 with a 64-bit operating system cannot be powered on or resumed in Workstation versions 5.0 and earlier.

Installing VMware Workstation 2

This chapter discusses how to install Workstation on your Linux or Windows host system. This chapter contains the following topics:

- "Installation Prerequisites" on page 43
- "Installing Workstation on a Windows Host" on page 44
- "Installing Workstation on a Linux Host" on page 49
- "Where to Go Next" on page 53

If you are upgrading rather than performing a fresh installation, see Chapter 3, "Upgrading VMware Workstation," on page 55.

Installation Prerequisites

Installing VMware Workstation is usually a simple process of running a standard installation wizard. This section outlines the tasks you need to perform before starting an installation, and it contains an important note about the compatibility of having multiple VMware products installed on the same computer as Workstation.

Before you begin installation, be sure you have:

- **Compatible host** – Verify that the computer and host operating system meet the system requirements for running Workstation, as described in "Host System Requirements" on page 29.
- **Workstation installation software** – If you bought the packaged distribution of Workstation, the installation software is on the CD in your package. If you bought the electronic distribution, the installation software is in the file you downloaded.

  VMware Workstation is available for both Windows and Linux host computers. The installation files for both host platforms are included on the same CD-ROM.

- **Workstation serial number** – Your serial number is on the registration card in your package. If you purchased Workstation online, the serial number is sent by email.

  Your serial number allows you to use Workstation only on the host operating system for which you licensed the software. For example, if you have a serial number for a Windows host, you cannot run the software on a Linux host. Make sure you enter the serial number for the correct operating system.

  To use Workstation on a different host operating system, purchase a license on the VMware Web site. You can also get an evaluation license at no charge for a 30-day evaluation of the software. For more information, go to www.vmware.com/download/.

- **A guest operating system** – After Workstation is installed, you will need the operating system installation CDs or OS images to set up your guest.

Sharing a Workstation Host with Other VMware Products

You cannot have VMware Workstation installed on the same host machine with another VMware product, such as VMware Server or the VMware Virtual Machine Console. The only VMware products that can share a host machine with Workstation are the VMware VirtualCenter client software and the VMware Converter. If you plan to install VMware Workstation on a host machine that already contains another VMware product, you must uninstall that product first.

After you have completed the prerequisites and determined which computer you want to use for hosting Workstation, see the appropriate installation section:

- "Installing Workstation on a Windows Host" on page 44
- "Installing Workstation on a Linux Host" on page 49

Installing Workstation on a Windows Host

Before you perform the installation procedure, make sure you have the Workstation 6 serial number ready. Although you can enter the number after installation, it is recommended at you enter it at installation time.

The following procedure describes how to run the Workstation installation wizard. If instead of running the wizard, you want to use the command-line interface to perform a silent installation on many computers, see "Installing Workstation Silently" on page 47.

To install Workstation on a Windows host

1 Log on to your Microsoft Windows host as the Administrator user or as a user who is a member of the Windows Administrators group.

To install Workstation on a Windows XP or Windows Server 2003 host computer, log on as local administrator (that is, do not log on to the domain, unless your domain account is also a local administrator).

Although an administrator must install Workstation on Windows XP or Windows Server 2003, a normal user—without administrative privileges—can run the program after it is installed.

NOTE You need one license for each user.

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2 From the **Start** menu, choose **Run**, and specify the path to either the CD-ROM drive or the downloaded installer file:

- If you are installing from a CD, enter **`D:\setup.exe`**, where `D:` is the drive letter for your CD-ROM drive.
- If you are installing from a downloaded file, browse to the directory where you saved the downloaded installer file, and run the installer. (The filename is similar to `VMware-workstation-<xxxx-xxxx>.exe`, where `<xxxx-xxxx>` is a series of numbers representing the version and build numbers.)

On Windows Vista, when the User Account Control dialog box appears, prompting you for permission to run the installer, click **Continue**.

NOTE If you have an earlier version of Workstation installed on your system, the installer removes that version before installing the new version. After the uninstallation is complete, you might be prompted to restart your computer before the installer can install the new version.

---

3 When the wizard opens and finishes computing space requirements, click **Next** to dismiss the Welcome page.

4 On the Setup Type page, select **Typical** unless you do not want to install the applicable Workstation IDE plug-ins, or if you have Eclipse installed in a non-standard location:

- If you have Visual Studio 2005 or Eclipse installed, the installer installs an integrated virtual debugger (IDE plug-in). If you don't want a plug-in installed, select the **Custom** setup, and select not to install that component.
- If you have Eclipse installed in a different directory than `C:\Eclipse` or `C:\Program Files\Eclipse` and you want to install the integrated virtual debugger for it, select the **Custom** setup, and select to install that component.

NOTE If you do not have Eclipse or Visual Studio installed, the plug-ins will not be installed. If you install one or both of these programs after you install Workstation, run the Workstation installer again and select the **Modify** option to install the plug-ins at that time.

Also, do not attempt to install the Eclipse Virtual Debugger on 64-bit Windows hosts.

If you select **Custom**, you can use the **Space** button to find out how much disk space is required for each component of the installation. Click the **Help** button for a description of what each type of icon in the list means.

5 On the Destination Folder page (for typical setups) or the Custom Setup page (for custom setups), if you do not want Workstation installed in the directory that is shown, click **Change** and specify the directory you want.

If you specify a directory that does not exist, the installer creates it for you.

CAUTION Do not install VMware Workstation on a network drive.

---

6 Click **Next**.

Windows and the Microsoft Installer limit the length of a path to a folder on a local drive to 255 characters. For a path to a folder on a mapped or shared drive, the limit is 240 characters. If the path exceeds this limit, an error message appears. You must select or enter a shorter path.

7 On the Configure Shortcuts page, deselect any shortcuts you do not want the installer to create.

8 On the Ready to Install the Program page, either click **Install** or click **Back** to make changes.

9 (Optional) After you click **Install**, on the Registration Information page, enter your name, company name, and serial number and click **Next**.

Your serial number is either on the registration card in your package or in an email from VMware if you purchased Workstation online. The user and company information you enter here is then made available in the About box (**Help>About VMware Workstation**).

If you skip this step, you must enter your serial number later, before you can power on a virtual machine.

NOTE If you are installing on a Windows Vista host, enter your serial number at this point to avoid permissions issues later. If the user who installs Workstation is an administrator but a non-administrator user later attempts to enter the serial number, that user will not have the required permissions.

---

10 When the wizard displays the Installation Wizard Completed page, click **Finish**.

Some installations might require that you reboot your computer. When you restart, you don't need to log in as a user with Administrator privileges.

Installing Workstation Silently

If you are installing Workstation on several Windows host computers, you might want to use the silent installation feature of the Microsoft Windows Installer. This feature is convenient, for example, in a large enterprise.

Before installing Workstation silently, ensure that the host computer has version 2.0 or higher of the MSI runtime engine. This version of the installer is available in versions of Windows beginning with Windows XP and is available separately from Microsoft. For additional details on using the Microsoft Windows Installer, see the Microsoft Web site.

To install Workstation silently

1 Silently extract the administrative installation image from the VMware Workstation installer:

```
setup.exe /a /s /v"/qn TARGETDIR=<InstallTempPath>"
```

`setup.exe` is the name of the installer on the CD distribution. If you are using a downloaded installer, the filename is similar to `VMwareWorkstation-<xxxx>.exe`, where `<xxxx>` is a series of numbers representing the version and build numbers.

`<InstallTempPath>` is the full path to the folder where you want to store the administrative installation image.

2 Run a silent installation using `msiexec` and the administrative installation image you extracted in the previous step:

```
msiexec –i "<InstallTempPath>\VMware Workstation.msi"
              [INSTALLDIR="<PathToProgramDirectory>"] ADDLOCAL=ALL
              [REMOVE=<featurename,featurename>] /qn
```

Enter the command on one line. To install Workstation in a location other than the default, change the path that follows `INSTALLDIR=` to specify the location.

Use the optional `REMOVE=<property>` to skip installation of certain features. The `REMOVE=<property>` setting can take one or more of the values listed in Table 2-1.

Table 2-1. Values for the `REMOVE` Property

Value	Description
`Authd`	VMware authorization service, which is used to perform tasks when you are not running Workstation as an Administrator.
`Network`	Networking components including the virtual bridge and the host adapters for host-only networking and NAT networking. Do not remove this component if you want to use NAT or DHCP.
`DHCP`	Virtual DHCP server.
`NAT`	Virtual NAT device.

If you specify more than one value, use a comma to separate the values. For example, `REMOVE=Authd,NAT`.

NOTE If you specify `REMOVE=Network`, the installer skips installation of certain networking components, including NAT and DHCP. There is no need to specify DHCP or NAT separately.

You can customize the installation further by adding any of the following installation properties to the command using the format `<property>="<value>"`. A value of 1 means true. A value of 0 means false. If you use the serial number property, enter the serial number with hyphens (xxxxx-xxxxx-xxxxx-xxxxx).

Table 2-2. `PROPERTY` Values

Property	Effect of the Property	Default
`DESKTOP_SHORTCUT`	Installs a shortcut on the desktop.	1
`DISABLE_AUTORUN`	Disables CD autorun on the host.	1
`REMOVE_LICENSE`	(Uninstall only) Removes all stored licenses at uninstall.	0
`SERIALNUMBER`	Enters the serial number.	

Uninstalling Workstation on a Windows Host

To uninstall Workstation, use the Add/Remove Programs control panel. Select the entry for VMware Workstation and click **Remove**. Follow the on-screen instructions.

On Windows Vista, go to **Start>Control Panel>Programs>Programs and Features> Uninstall a program**. Select **VMware Workstation** and click **Uninstall**.

Installing Workstation on a Linux Host

Before you begin, read the following notes and make adjustments to your host system:

- If you have a previous tar installation, delete the previous `vmware-distrib` directory before installing from a tar file again. The location of this directory depends on where you placed it when you did the previous installation. Often it is placed in:

  `/tmp/vmware-distrib`

- The real-time clock function must be compiled into your Linux kernel.
- Workstation for Linux requires that the parallel port PC-style hardware option (CONFIG_PARPORT_PC) be built and loaded as a kernel module (that is, it must be set to `m` when the kernel is compiled).
- To use the Workstation Help system, you must have a Web browser installed on your host computer.

NOTE The following procedure describes an installation from a CD-ROM disc. If you downloaded the software, the steps are the same, except that you start from the directory where you saved the installer file you downloaded, not from the `Linux` directory on the CD.

To install Workstation on a Linux host

1. Log on to your Linux host with the user name you plan to use when running Workstation.
2. In a terminal window, use the following command to become root so you can perform the initial installation steps:

   ```
   su -
   ```

3. Mount the Workstation CD-ROM.
4. Change to the `Linux` directory on the CD.

5 Continue installation with the appropriate section for your desired installer:

- "Using the tar Installer" on page 50
- "Using the RPM Installer" on page 50

Using the tar Installer

You can skip the steps for copying and unpacking the archive and install directly from the `vmware-distrib` directory on the CD:

a Copy the tar archive to a temporary directory on your hard drive (for example, `/tmp`):

```
cp VMware-<xxxx>.tar.gz /tmp
```

b Change to this temporary directory:

```
cd /tmp
```

c Unpack the archive:

```
tar zxpf VMware-<xxxx>.tar.gz
```

d Change to the installation directory:

```
cd vmware-distrib
```

e Run the installation program:

```
./vmware-install.pl
```

f Accept the default directories for the binary files, library files, manual files, documentation files, and `init` script.

g Enter **`Yes`** when prompted to run `vmware-config.pl`.

h Respond to the prompts, as described in "Running vmware-config.pl" on page 52.

Using the RPM Installer

a Run RPM specifying the installation file:

```
rpm -Uhv VMware-<xxxx>.rpm
```

`VMware-<xxxx>.rpm` is the installation file on the CD. In place of `<xxxx>` the filename contains numbers that correspond to the version and build.

b Run the configuration program:

```
vmware-config.pl
```

c Respond to the prompts, as described in "Running vmware-config.pl" on page 52.

Configuring Workstation with vmware-config.pl

This section describes how to use `vmware-config.pl` to configure your installation of VMware Workstation.

NOTE If you run the RPM installer, you need to run this program separately from the command line. If you install from the tar archive, the installer offers to launch the configuration program for you. Answer **`Yes`** when you see the prompt.

Required Configuration Changes

Configuration with `vmware-config.pl` is required in the following circumstances:

- When you install VMware Workstation the first time.
- When you upgrade your version of Workstation.
- When you upgrade your host operating system kernel. (It is not necessary to reinstall Workstation after you upgrade your kernel.)
- To reconfigure the networking options for Workstation—for example, to add or remove host-only networking.

Location of vmware-config.pl

The installer places `vmware-config.pl` in `/usr/bin`. If `/usr/bin` is not in your default path, run the program with the following command:

```
/usr/bin/vmware-config.pl
```

Running vmware-config.pl

After you run the installer to perform a fresh installation or an upgrade, you need to run `vmware-config.pl`. If you have not already done so, open a terminal window and become root before performing the following procedure.

To use vmware-config.pl

1 Use the following command to start the program if necessary:

```
vmware-config.pl
```

2 Respond to the prompts. In most cases, the default response is appropriate.

Take the following considerations into account:

- If you do not enable host-only networking when you install Workstation, you cannot allow a virtual machine to use both bridged and host-only networking.
- If you have Eclipse installed and want to install Workstation's Integrated Virtual Debugger for Eclipse, enter **`Yes`**, when prompted. (The default is **`No`**.)
- If you want to install the Integrated Virtual Debugger for Eclipse, when you are prompted to install the VIX API and accept its license agreement, do so. The debugger cannot run without the VIX API.

If the configuration program does not display a message saying the configuration completed successfully, run the configuration program again.

3 When done, exit from the root account:

```
exit
```

The first time you attempt to power on a virtual machine, you are prompted to enter the Workstation 6 serial number.

Uninstalling Workstation on a Linux Host

This section provides instructions for uninstalling an RPM installation and a tar installation.

Uninstalling an RPM Installation of Workstation

If you used the RPM installer to install Workstation, remove the software from your system by using the following command:

```
rpm –e VMwareWorkstation<xxxx>
```

Where <xxxx> is a series of numbers representing the version and build. If you have Workstation properly installed, you can find the Workstation build number by running:

```
rpm –qa | grep VM
```

Uninstalling a tar Installation of Workstation

If you used the tar installer to install Workstation, remove the software from your system by using the following command:

```
vmware-uninstall.pl
```

Where to Go Next

After Workstation is installed, you will:

1 Create a virtual machine.

See Chapter 5, "Creating a New Virtual Machine," on page 87.

2 Install a guest operating system in the new virtual machine.

See "Installing a Guest Operating System" on page 95 or the *VMware Guest Operating System Installation Guide*, available from the **Help** menu.

3 Install the VMware Tools package in the virtual machine.

See Chapter 6, "Installing and Using VMware Tools," on page 111.

4 Start using the virtual machine.

See Chapter 4, "Learning Workstation Basics," on page 63 and Chapter 7, "Running a Virtual Machine," on page 147.

Upgrading VMware Workstation 3

This chapter discusses how to upgrade VMware Workstation 4 or 5 on your Linux or Windows host system, and how to use existing virtual machines under Workstation 6. This chapter contains the following topics:

- "Preparing for the Upgrade" on page 55
- "Upgrading on a Windows Host" on page 57
- "Upgrading on a Linux Host" on page 58
- "Using Workstation 4 or 5 Virtual Machines in Workstation 6" on page 59

Direct upgrades from a Workstation 3 virtual machine are not supported in Workstation 6.

Preparing for the Upgrade

This section lists the tasks you need to perform to ensure the best possible upgrade experience.

Removing Snapshots and Shutting Down Suspended Virtual Machines

To use virtual machines created in an earlier version of Workstation, you can upgrade the virtual machine after you upgrade to the new release of Workstation. If the virtual machine was created with a version of Workstation earlier than Workstation 5.5 and it has a snapshot, remove the snapshot before upgrading, as described in "Working with Snapshots in the Snapshot Manager" on page 231.

Shut down virtual machines completely before you remove the version of Workstation that you used to create them. If a virtual machine is suspended, resume it, shut down the guest operating system, and power off the virtual machine.

NOTE If you attempt to resume a virtual machine that was suspended under a different VMware product or a different version of Workstation, a dialog box gives you the choice of discarding or keeping the file that stores the suspended state. To recover the suspended state, click **Keep**, and resume the virtual machine under the correct VMware product or version. If you click **Discard**, you can power on normally, but the suspended state is lost.

Backing Up Virtual Machines

Back up all the files in your virtual machine directories for any existing Workstation 4 or 5 virtual machines you plan to migrate to Workstation 6. This includes `.vmdk` or `.dsk`, `.vmx` or `.cfg`, and `.nvram` files. Depending on your upgrade path, you might not be able to run your virtual machines under both Workstation 6 and your previous version of Workstation.

Direct upgrades from a Workstation 2 or 3 virtual machine are not supported in Workstation 6.

Removing Workstation 2 or 3 to Install Workstation 6

To install Workstation 6 on a computer where Workstation 2 or 3 is already installed, uninstall the old version before installing the new one.

On a Windows host, the uninstaller might ask to remove licenses from your registry. If there is any possibility that you might want to reinstall the old version, do not allow the uninstaller to remove the licenses. You can safely keep licenses for multiple VMware products on the computer at the same time.

On a Linux host, the license remains in place. You can safely leave the license where it is.

When the old version has been uninstalled, you can install Workstation 6, as described in the following sections:

- "Installing Workstation on a Windows Host" on page 44
- "Installing Workstation on a Linux Host" on page 49

NOTE If you have Workstation version 2 or 3 virtual machines that you want to use with Workstation 6, upgrade the virtual machines to at least Workstation version 4 before you install Workstation 6.

Upgrading on a Windows Host

You can upgrade from Workstation version 4 or 5 to version 6 by running the VMware Workstation 6 installation program, as described in this section. Make sure that you have a Workstation 6 serial number before you start. Upgrades from earlier versions of Workstation are not supported. For more information, see "Removing Workstation 2 or 3 to Install Workstation 6" on page 56.

To upgrade from Workstation version 4 or 5

1 Log in to your Microsoft Windows host as the Administrator user or as a user who is a member of the Windows Administrators group.

2 Launch the Workstation 6 installer from your download directory or CD-ROM.

Workstation automatically uninstalls the previous version.

3 Reboot your computer if you are prompted to do so, and log in again as the Administrator user or as a user who is a member of the Windows Administrators group.

4 Complete the installation wizard.

For detailed instructions on running the installer, see "Installing Workstation on a Windows Host" on page 44.

5 Reboot your computer if you are prompted to do so.

You can now log in as you normally do. You do not need to log in as an Administrator now that Workstation is installed.

Upgrading to a Windows Vista Host

This section provides instructions for various upgrade scenarios that involve Windows Vista. In sections that instruct you to uninstall Workstation 5, you need only uninstall the VMware Workstation *application*, not the virtual machines that you have created. After you uninstall Workstation 5 and then install Workstation 6, you can power on the virtual machines and upgrade them if you want to. This procedure is described in "Changing the Version of the Virtual Machine" on page 59.

During the upgrade from Windows XP to Windows Vista, the location of virtual machines might get changed. The Windows Vista upgrade uses the registry to map the previous location of any virtual machines stored in:

```
C:\Documents and Settings\<user>\My Virtual Machines
```

to

```
C:\Users\<user>\Documents\My Virtual Machines
```

After the upgrade is complete, the **Favorites** list in Workstation should work correctly.

Workstation 5 on Windows XP to Workstation 6 on Windows Vista

If you have Workstation 5 installed on a Windows XP host, first, uninstall Workstation 5. Use the Control Panel's **Add/Remove Programs** item to uninstall Workstation. Next, upgrade the operating system to Windows Vista. Finally, install Workstation 6, as described in "Installing Workstation on a Windows Host" on page 44.

Workstation 5 on Windows Vista to Workstation 6 on Windows Vista

If you have Workstation 5 installed on a Windows Vista host, first, uninstall Workstation 5. Go to **Start>Control Panel>Programs>Programs and Features>Uninstall a program**. Select **VMware Workstation** and click **Uninstall**. Next, install Workstation 6, as described in "Installing Workstation on a Windows Host" on page 44. Workstation 5 was only experimentally supported on Windows Vista.

Workstation 6 on Windows XP to Workstation 6 on Windows Vista

The instructions in this section assume that you have Windows XP with Service Pack 2.

To upgrade Workstation 6 from Windows XP to Windows Vista

1. Log in as the Administrator user or as a user who is a member of the Windows Administrators group.
2. Make sure that Workstation is not running and that no virtual machines are running in the background.
3. Upgrade the host operating system to Windows Vista, as described in the Microsoft documentation.
4. Start Workstation and power on a virtual machine.

Upgrading on a Linux Host

You can upgrade from Workstation version 4 or 5 to version 6 by running the VMware Workstation 6 installation program, as described in Chapter 2, "Installing VMware Workstation," on page 43. Make sure that you have a Workstation 6 serial number before you start. You will be prompted to enter the serial number after installation is complete, when you first attempt to start Workstation 6.

NOTE Starting with Workstation 5, Samba is no longer automatically configured when you run `vmware-config.pl`.

If you used the tar installer to install Workstation version 4 or 5 and you plan to use the tar installer for version 6, you do not need to uninstall the older version.

Similarly, if you used the RMP installer to install version 4 or 5 and you plan to use the RMP installer for version 6, you do not need to uninstall the older version.

If you used a tar installer to install version 4 or 5, and you want to use the RPM installer for version 6, or the reverse, you do not need to uninstall the older version.

Using Workstation 4 or 5 Virtual Machines in Workstation 6

Use either of these approaches:

- "Using an Older-Version Virtual Machine Without Upgrading" on page 59
- "Changing the Version of the Virtual Machine" on page 59

Using an Older-Version Virtual Machine Without Upgrading

You might not want to upgrade a virtual machine because you want it to remain compatible with other VMware products you are using. Following is a brief summary of VMware product version compatibility:

- A virtual machine created in Workstation 4.x is compatible with GSX Server 3.x, ESX Server 2.x, and ACE 1.0.
- A virtual machine created in Workstation 5.x is compatible with VMware Server 1.x, ESX Server 3.x, and VMware Player 1.x.

You can run these virtual machines in Workstation 6, but you will not have the benefits of the new features of Workstation 6.

For more information about compatibility between VMware products, refer to the *VMware Virtual Machine Mobility Planning Guide*.

If you decide not to upgrade a virtual machine, you still need to upgrade VMware Tools to the new version. Follow the instructions for your guest operating system in "Installing and Upgrading VMware Tools" on page 113. Do not remove the older version of VMware Tools before installing the new version.

Changing the Version of the Virtual Machine

If you created virtual machines with an earlier version of Workstation, you will probably want to upgrade to the latest version so that you can enjoy the benefits of the newest features. For more information about new features, see "What's New in Version 6" on page 21.

If, however, you created Workstation 6 virtual machines but you now want to deploy those virtual machines to run on a different VMware product, you might need to downgrade to a version that is compatible with that product.

The Change Version wizard enables you to do either of these tasks.

Using Workstation 6, you have the following upgrade and downgrade choices:

- Upgrade a Workstation 4 virtual machine to either version 5 or version 6.
- Upgrade a Workstation 5 virtual machine to version 6 or downgrade it to version 4.
- Downgrade a Workstation 6 virtual machine to either version 4 or version 5.

The Change Version wizard also helps you determine which virtual hardware version to use.

Consider the following when changing the virtual hardware version of a virtual machine:

- The wizard lets you either change the version of the original virtual machine or create a full clone, so that the original remains unaltered.
- If you upgrade a Workstation 4 or 5 virtual machine that is compatible with ESX Server to Workstation 6, you will not be able to later downgrade it again to an ESX-compatible virtual machine by using the Change Version wizard.

  On Windows hosts, you can, however use the Converter Import wizard (**File>Import**) to perform such a downgrade.
- If you are upgrading a virtual machine that runs from a physical disk, you might see the following error message while Workstation is upgrading the virtual machine: "Unable to upgrade <drivename>. One of the supplied parameters is invalid." Click **OK** to continue the upgrade process.
- When you upgrade a Windows XP, Windows Server 2003, or Windows Vista virtual machine, the Microsoft product activation feature might require you to reactivate the guest operating system.
- Make backup copies of your virtual disks before starting the upgrade or downgrade.

To change the virtual hardware version of a virtual machine

1 In the guest operating system, make a note of the NIC settings.

Specifically, if you have specified a static IP address for this virtual machine, after the upgrade, that setting could get changed to automatic assignment by DHCP.

To check the NIC settings, use the method appropriate for your operating system. For example, on Windows XP, you can use the Control Panel's Network Connections item to find information about the TCP/IP address for the virtual machine.

2 Shut down the guest operating system and power off the virtual machine.

3 Select the virtual machine and, from the Workstation menu bar, choose **VM>Upgrade or Change Version**.

4 Complete the pages of the Change Version wizard.

When you select a hardware compatibility version, you see a list of the VMware products that are compatible with that version. If you select Workstation 4 or 5, you also see a list of Workstation 6 features that are not supported for that version.

5 Power on the virtual machine.

6 In the guest operating system, check the NIC settings and adjust them if they changed, as described in Step 1.

7 If the virtual machine does not have the latest version of VMware Tools installed, upgrade VMware Tools.

Even if, for example, you upgraded a version 4 virtual machine to version 5 rather than version 6, you should still upgrade VMware Tools to the version of Tools included with Workstation 6. Refer to "Installing and Upgrading VMware Tools" on page 113. Do not remove the older version of VMware Tools before installing the new version.

NOTE If you are upgrading a virtual machine that runs from a physical disk, you can safely ignore the message: "Unable to upgrade <drivename>. One of the supplied parameters is invalid." Click **OK** to continue the upgrade.

Learning Workstation Basics

4

This chapter discusses launching the Workstation program and introduces the VMware Workstation window. This chapter contains the following topics:

- "Starting Workstation" on page 64
- "Overview of the Workstation Window" on page 64
- "Checking for Product Updates" on page 76
- "Introduction to Creating a Virtual Machine" on page 77
- "Introduction to Workstation Preferences" on page 79
- "Introduction to Virtual Machine Settings" on page 81
- "Closing Virtual Machines and Exiting Workstation" on page 84
- "Keyboard Shortcuts" on page 85

The illustrations in these sections show a Windows XP guest operating system.

Starting Workstation

The method of starting the Workstation application depends on your host operating system.

To start Workstation on a Windows host

1 From the **Start** menu, choose **Start>Programs>VMware>VMware Workstation**, or double-click the shortcut on your desktop.

2 If this is the first time you have launched Workstation, read and accept the end user license agreement (EULA).

The VMware Workstation window opens.

To start Workstation on a Linux host

1 Open a terminal window.

2 Type **`vmware &`** and press Enter.

By default, the installer places the file in `/usr/bin`. If `/usr/bin` is not in your default path, run the program with the following command:

```
/usr/bin/vmware &
```

NOTE On Linux hosts, the Workstation installer adds an entry to the **Start** menu for VMware Workstation. This menu entry is located in different submenus, depending on your Linux distribution. For example:

SUSE Linux 9.1: **Start>System>More Programs>VMware Workstation**

Red Hat Enterprise Linux AS/WS Release 3: **Start>System Tools>More System Tools>VMware Workstation**

---

3 Read and accept the end user license agreement (EULA).

The Workstation window opens.

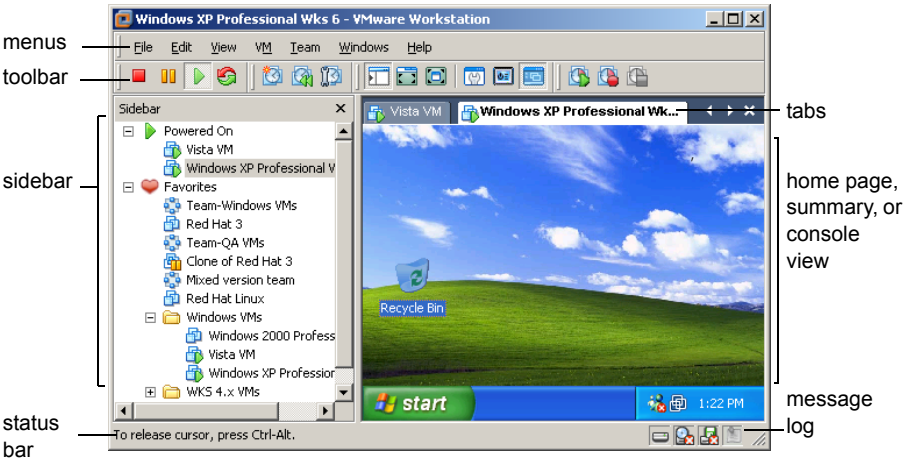
Overview of the Workstation Window

A Workstation virtual machine is like a separate computer that runs in a window on your physical computer. However, Workstation displays more than the screen of another computer. From the Workstation window, you can access and run your virtual

machines and teams of virtual machines. You can also switch easily from one to another.

This section shows you how to navigate and use the VMware Workstation window, and how to set up a list of favorites. Favorites are virtual machines and teams that you use often and want to access quickly.

Figure 4-1. VMware Workstation Window



The VMware Workstation window contains the following sections:

- **Home page, summary, console, or appliance view** – This main part of the window shows your virtual machines.
- **Tabs** – Each open virtual machine has its own tab. Click a tab to make that virtual machine active. Click the X to close the tab. Depending on how you configure Workstation, the virtual machine is then either powered off or continues to run in the background.
- **Sidebar** – Bookmark your favorite virtual machines and teams of virtual machines for quick access. You can also see which virtual machines are powered on. Right-click context menus enable you to perform many operations on a selected virtual machine.

  If you have Workstation ACE Edition, an additional section of the sidebar displays ACE Management Servers. For a description of this product, see "Upgrade Path to Workstation ACE Edition" on page 21.

- **Status bar** – This area displays Workstation messages and an icon for each removable device. You can right-click an icon to disconnect it or edit its configuration.
- **Message log**— A note icon that indicates whether any unread messages are present in the message log for the selected virtual machine. If the icon is dimmed, all messages have been read. To open the message log, either double-click the icon or right-click it and choose **Open Message Log**. Alternatively, from the menu bar, choose **VM>Message Log**.

  Messages include warning information about the virtual machine, such as "Could not connect to the floppy drive" or "No bootable device was detected." Select an item in the message log to see a longer description of the message.

Home Page and Views

Workstation displays one of four views in the main part of the window: the home page, the summary view, the console view, or the appliance view.

Home Page

Click the **Home** tab to display the Workstation home page. Use the icons on the home page to start creating a new virtual machine or open an existing virtual machine.

To close the home page, click the X to the right of the tabs on a Windows host or the X on the tab on a Linux host. To display the home page again, choose **View>Go to Home Tab**.

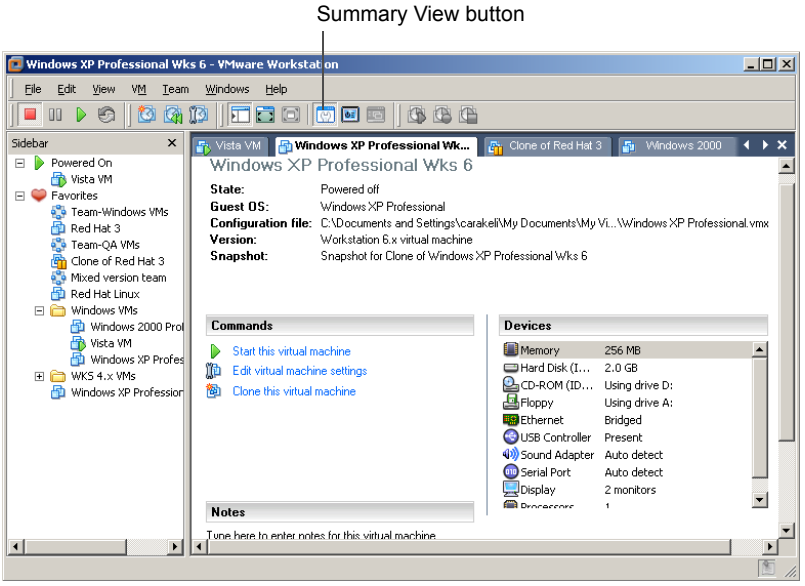
Summary View

When you select a tab for a powered-off virtual machine or team of machines, Workstation displays a summary of the configuration information about that item. Workstation also displays a summary for a suspended virtual machine or team. Click the **Summary** toolbar button at any time to examine settings in the summary view.

NOTE Summary tabs appear only for virtual machines that are currently open. To open a virtual machine that is not displayed, choose **File>Open>Virtual Machine**, navigate to the virtual machine's `.vmx` file, and select **Open**. The summary or console tab remains visible as long as the virtual machine remains open.

Figure 4-2 shows an example of the summary view for Workstation. The summary view for Workstation ACE Edition includes additional sections for policies, package settings and history, and other ACE-specific functionality. For more information, see the *VMware ACE Administrator's Manual*.

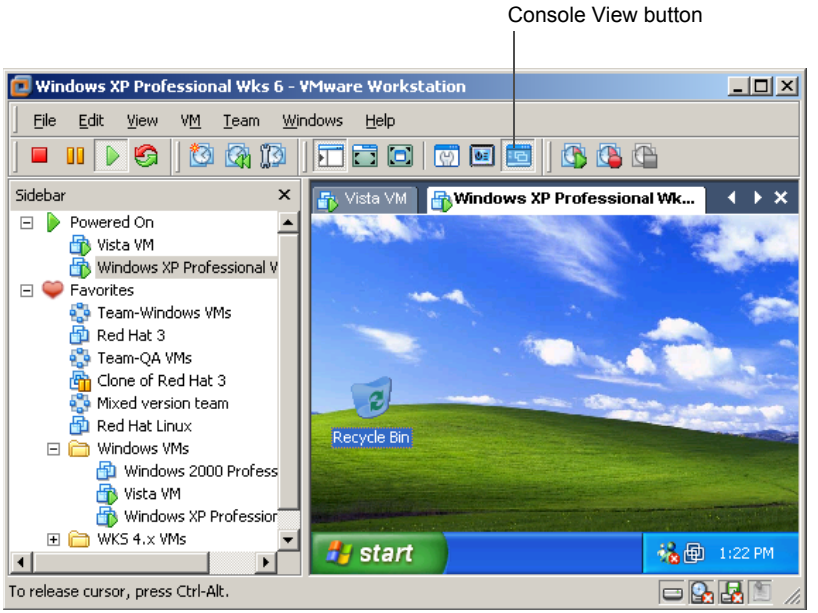
Figure 4-2. Summary View for a Virtual Machine (Windows Host)



Console View

The console view for an active virtual machine is like the monitor display of a physical computer.

Figure 4-3. Console View (Windows Host)

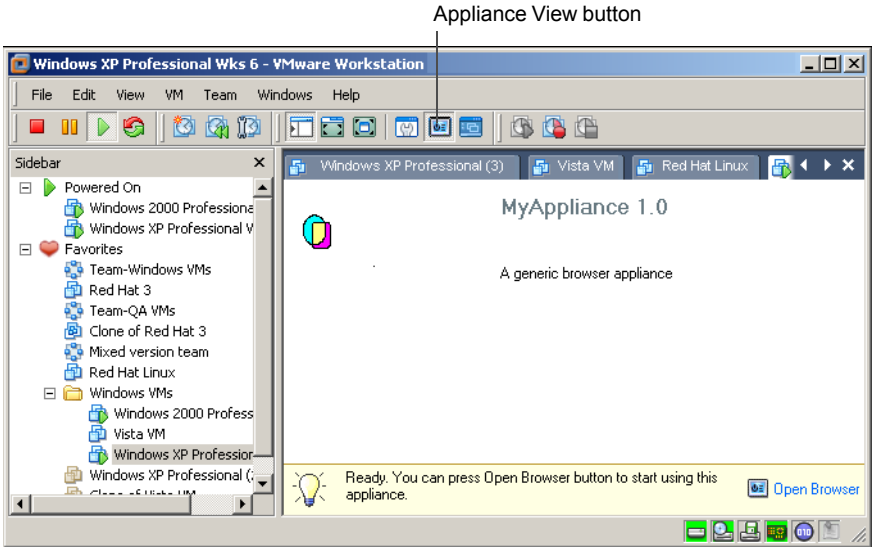


When a virtual machine is active, the name of the virtual machine or team of virtual machines is displayed in a tab at the top of the console. To switch from the active virtual machine or team, click the tab of another virtual machine or team. You can use the console tabs in the windowed mode and also in the quick switch mode.

Appliance View

If you set up the virtual machine to act as an "appliance," such as a Web server with a browser-based console, you can specify that the default view should be an appliance view. The appliance view gives you a brief description of the type of server or appliance and provides a link that opens the browser on the host system and connects to the appliance's management console.

Figure 4-4. Appliance View (Windows Host)



Appliance view is available only for virtual machines that you designate as appliances, as described in "Displaying the Virtual Machine as an Appliance" on page 168.

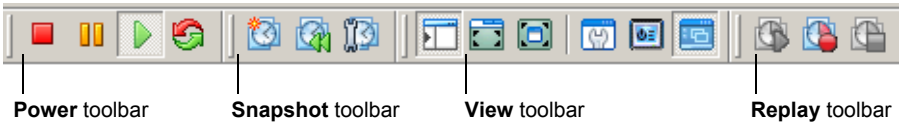
Displaying Multiple Virtual Machines at the Same Time

To simultaneously view more than one virtual machine when they are not all on the same team, open multiple Workstation windows and launch one or more virtual machines in each Workstation window. Alternately, use a team to coordinate and use multiple virtual machines within a single console window. See "Viewing Teams and Their Virtual Machines" on page 258 for a complete description of the console view for teams.

Toolbar Buttons

The toolbar area at the top of the VMware Workstation window contains buttons you can click to power your virtual machines on and off, change the Workstation display, manage snapshots, and record virtual machine activity.

Figure 4-5. Workstation Toolbar



The following list describes the toolbar buttons. To customize the toolbar display, see "Customizing the Toolbar" on page 72.

CAUTION When a team is active, clicking the **Power On**, **Power Off**, **Suspend**, **Resume**, or **Reset** button affects all the virtual machines in that team.

- **Power** toolbar:
  - **Power Off** – Turns off the active virtual machine or team like the power button on a hardware PC. You can configure Workstation for a soft power off (called shut down) or a hard power off (called power off). See "Shutting Down a Virtual Machine" on page 152 or "Starting and Stopping Teams" on page 262.
  - **Suspend** – Stops a virtual machine or team in a manner that allows you to resume your work later. See "Using the Suspend and Resume Features" on page 223.
  - **Power On** or **Resume** – Powers on a selected virtual machine or team that is powered off, or resumes a virtual machine or team that is suspended.
    - **Power On** – See "Starting a Virtual Machine" on page 148, or "Starting and Stopping Teams" on page 262.
    - **Resume** – See "Using the Suspend and Resume Features" on page 223.
  - **Reset** – Resets a virtual machine or team like the reset button on a physical PC. See "Powering Off Versus Shutting Down and Resetting Versus Restarting" on page 152.
- **Snapshot** toolbar:
  - **Take Snapshot** – Allows you to save the state of a virtual machine in the same manner you might save a word-processing document. You can come back to that state if you make a mistake by using the **Revert** button. See "Using Snapshots" on page 225.
  - **Revert** – Allows you to return a virtual machine to the parent state, a state previously preserved by taking a snapshot. See "Using Snapshots" on page 225.
  - **Manage Snapshots** – Opens the snapshot manager, where you can view the virtual machine's existing snapshots, revert to a snapshot, take a new snapshot, and make a clone from a snapshot. See "Working with Snapshots in the Snapshot Manager" on page 231.

- **View** toolbar:
  - **Show or Hide Sidebar** – Toggles between showing and hiding the sidebar. See "Sidebar" on page 73.
  - **Quick Switch** – Enlarges the Workstation console to cover the entire host monitor. Console tabs are visible, allowing you to switch between your virtual machines and teams with a single click. See "Using Quick Switch Mode" on page 157.
  - **Full Screen** – Enlarges the virtual machine display to cover the entire host monitor. The virtual machine no longer appears in a window. See "Using Full Screen Mode" on page 156.

    NOTE Workstation menus and toolbar are not visible in full screen mode. Move your cursor to the top of the screen to show the full screen toolbar. Press Ctrl+Alt+Enter to restore the Workstation window.

    If you cannot enter full screen mode when the guest's display mode is smaller than the host's display mode, try adding the following line to the virtual machine's configuration (`.vmx`) file:

    ```
    mks.maxRefreshRate=1000
    ```

    See "Files That Make Up a Virtual Machine" on page 108 for a description of this file.
  - **Summary View** – Displays the summary view. See "Summary View" on page 66.
  - **Appliance View** – Displays the appliance view. See "Appliance View" on page 68.
  - **Console View** – Displays the console view. See "Console View" on page 68.
- **Replay** toolbar:
  - **Replay Last Recording** – Plays the last recording made for this virtual machine.
  - **Record** – Begins recording the activity of this virtual machine.
  - **Stop** – Stops recording the activity of this virtual machine.

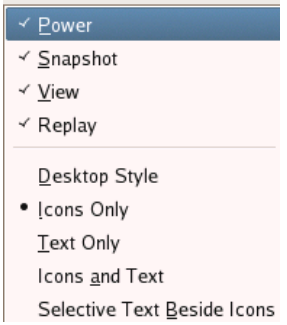
  For information about the experimental record/replay feature, see "Recording and Playing Back Virtual Machine Activity" on page 240.

Customizing the Toolbar

You can customize the Workstation toolbar by adding, removing, and rearranging toolbar buttons. On a Windows host, the toolbar buttons are arranged in separate toolbars for power buttons, snapshot buttons, view buttons, and record/replay buttons. On a Linux host, all the buttons are contained in a single toolbar.

To customize the toolbar display on a Linux host

1 Right-click the far-right side of the toolbar to display a **Toolbar** menu.



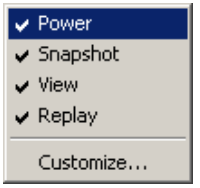
2 Choose **Power**, **Snapshot**, **View**, or **Replay** to add or remove the corresponding toolbar buttons.

When a choice is checked, the corresponding buttons are displayed.

3 In the lower part of the menu, choose the display style for toolbar buttons.

To customize the toolbar display on a Windows host

1 Right-click any part of the toolbar to display a **Toolbar** menu.



2 Click **Power**, **Snapshot**, **View**, or **Replay** to add or remove that toolbar.

When a toolbar is checked, it is displayed.

To change which buttons appear in a toolbar or the order in which they appear, display that toolbar and continue with the following steps.

3 Right-click the **Power**, **Snapshot**, **View**, or **Replay** toolbar to open the Customize Toolbar window.

The Customize Toolbar window for that toolbar appears. Buttons listed under Current Toolbar Buttons are displayed in the toolbar, in the order shown in the Customize Toolbars window.

4 Make any of the following changes:

- To add or remove a button from the toolbar, select the button and click **Add** or **Remove**. Add a separator to display a vertical line between the buttons.
- To change the order of the buttons, select any button under **Current Toolbar Buttons** and click **Move Up** or **Move Down** to rearrange the buttons.

  You can also change the order of the currently displayed buttons without opening the Customize Toolbar window: Hold down the Shift key while you drag and drop a button to a different location in the toolbar.
- To restore the default setup, with all buttons displayed, click **Reset**.

5 Click **Close**.

Sidebar

The sidebar contains a list of favorites and shows which virtual machines or teams of virtual machines are currently powered on. If you have Workstation ACE Edition, an additional section of the sidebar displays ACE Management Servers. (For a description of this product, see "Upgrade Path to Workstation ACE Edition" on page 21.)

To toggle the display of the Sidebar list on or off

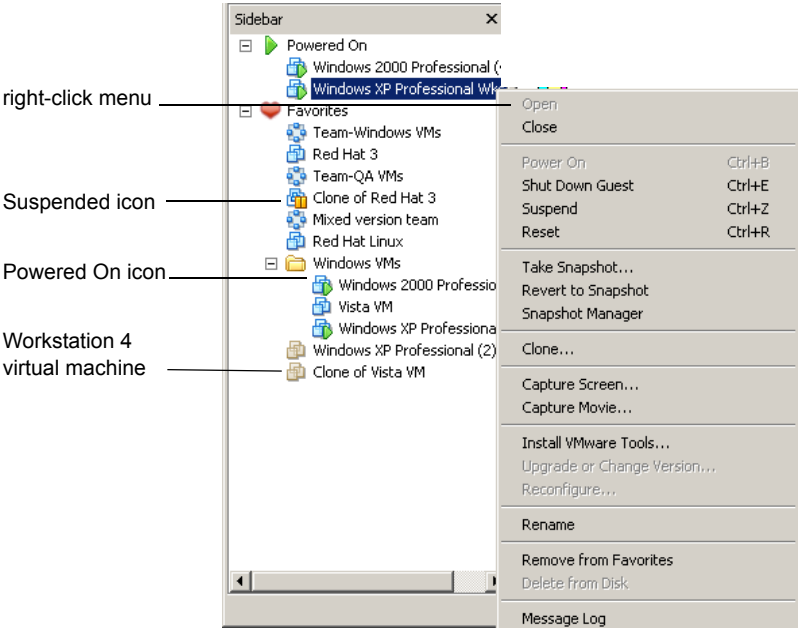
Choose **View>Sidebar**.

If the sidebar was visible, it becomes hidden. If it was hidden, it is displayed.

The Favorites List

The **Favorites** list lets you organize and access frequently used items.

Figure 4-6. Favorites List in the Sidebar



The **Favorites** list provides the following benefits:

- **Fast access** – Quickly access frequently used items. With your virtual machines and teams on the **Favorites** list, you can open them without browsing the host file system. Also like browser bookmarks, **Favorites** list icons can be organized in folders, added, rearranged, or deleted.
- **Status** – Different icons indicate the status of virtual machines and teams. A **Favorites** list icon indicates whether the team or virtual machine is powered off, powered on, or suspended. A brown (rather than blue) virtual machine icon indicates that the virtual machine is a Workstation 4 virtual machine.
- **Right-click commands** – Right-click on a **Favorites** icon to display a menu of commands you can use for that virtual machine or team. You can click elsewhere in the **Favorites** list (that is, not on a virtual machine or team) to display a context menu from which you can choose to create a new virtual machine, team, or folder. You can also open an existing virtual machine, team, Microsoft Virtual PC or Virtual Server virtual machine, StorageCraft, or Symantec Backup Exec System Recovery system image.

To create folders for organizing favorites

1 Right-click **Favorites** (or any item in the **Favorites** list), and choose **New Folder**.

2 Complete the New Folder dialog box that appears.

You can also drag and drop folders to place one inside another.

3 Drag and drop Favorites items in the desired folder.

To add a virtual machine or team entry to the Favorites list

1 Launch Workstation. For instructions, see "Starting Workstation" on page 64.

2 Choose **File>Open** and browse to the location of the virtual machine (`.vmx` file) or team (`.vmtm` file) that you want to add as a favorite.

3 Choose **File>Add to Favorites**.

The virtual machine or team name appears in the **Favorites** list.

To add a powered on virtual machine or team to the Favorites list

1 In the sidebar, right-click the virtual machine or team in the **Powered On** list.

2 From the context menu that appears, choose **Add to Favorites**.

The virtual machine name appears in the **Favorites** list.

To remove a name from the Favorites list

1 Click a name in the **Favorites** list to select it.

2 Choose **File>Remove from Favorites**.

The virtual machine name is removed from the **Favorites** list.

You can remove the name of a virtual machine from the **Favorites** list at any time. Removing the name does not affect the virtual machine's files or operation. You can add the virtual machine to the list again at any time.

To remove the currently open virtual machine from the Favorites list

Choose **File>Remove from Favorites**.

The virtual machine is removed from the **Favorites** list.

To rename a Favorite list entry for a virtual machine or a team

1 Right-click the Favorites item you want to rename.

2 Choose **Rename** from the context menu.

3 Type the new name for the item and press Enter.

Another way to change the name of a virtual machine or team is to choose **VM>Settings>Options>General** (for a virtual machine), or **Team>Settings>Options** (for a team), and type the new name into the **Name** field.

NOTE Changing the name is for display only and does not rename the virtual machine files on the host.

Powered On List

This list enables you to find out which virtual machines or teams are currently powered on. Right-click items in the **Powered On** list to display a menu of commands you can use for that virtual machine or team.

Alternatively, you can see the same information about which machines are powered on by right-clicking the virtual machine status icon in the notification area of your host's taskbar.

Checking for Product Updates

Workstation automatically checks for product updates. By default, it checks once a week, at the time you launch Workstation. You can change the interval for the automatic checks by using the following procedure.

To have VMware Workstation check for updates

1 Choose **Edit>Preferences>Workspace**.

2 On the **Check for Software Updates** drop-down menu, set the interval.

The **Software updates** section of the **Workspace** tab shows the time and result of the most recent automatic check for updates and the time of the next scheduled check.

You can check for updates manually by choosing **Help>Check for Updates on the Web**. Alternatively, on Linux, click **Check Now** on the **Workspace** tab of the preferences editor (from the Workstation menu bar, choose **Edit>Preferences**).

NOTE Checking for product updates works only if the host computer is connected to the Internet.

Introduction to Creating a Virtual Machine

The instructions in this section get you started quickly with creating a virtual machine. Once you create a virtual machine, you will find the information in the rest of this chapter easier to understand.

The instructions in this section tell you to accept the default settings so that you can complete the New Virtual Machine wizard quickly. Completing the procedure is like completing a tutorial. Later, when you want to create virtual machines that you actually use in your work or in a production environment, you will want gain a deeper understanding of all the options available. This detailed information is provided in Chapter 5, "Creating a New Virtual Machine," on page 87.

If you have an installation CD for a particular operating system, use the following procedure. For simplicity, it's recommended that you use a Windows installation CD. Most Windows operating systems fit on one CD-ROM, whereas Linux requires multiple CDs.

To create a virtual machine and install the guest operating system

1 Start VMware Workstation.

For instructions, see "Starting Workstation" on page 64.

2 Choose **File>New>Virtual Machine**, to start the New Virtual Machine wizard and click **Next**.

3 In the Select the Appropriate Configuration page, select **Typical** and click **Next**.

4 On the Select a Guest Operating System page, select the operating system (including the version) that you intend to install in the new virtual machine and click **Next**.

5 Complete the rest of the wizard pages as follows:

- Name the Virtual Machine page – Click **Next** to accept the default.
- Network Type page – Select NAT and click **Next**. For Windows guests, it is recommended that you use NAT until you install security software, such as antivirus software.
- Specify Disk Capacity page – Click **Finish**.
- Virtual machine created successfully – Click **Close**.

The virtual machine is created and its name is added to the **Favorites** list.

6 Insert the installation disc for the operating system in the host computer's CD-ROM drive.

7 In the Workstation window, on the tab for the newly created virtual machine, in the **Commands** section, click **Start this virtual machine**.

On Linux hosts, the command is called **Power on this virtual machine**.

The console view for the virtual machine appears. Soon the boot device (the CD-ROM) is detected and you are prompted to begin installation of the operating system.

8 Follow the installation instructions provided by the operating system vendor.

After you finish installing the guest operating system, you can install VMware Tools, as described in the next step. Make sure the guest operating system is running and, if necessary, you are logged in.

9 From the Workstation menu bar, choose **VM>Install VMware Tools**, and complete the installation wizard that appears in the guest operating system.

Accept the default settings provided in the wizard.

It is assumed that you are using a Windows guest operating system. Installing VMware Tools in a Windows system is a simple matter of clicking **Next** to complete the wizard. Installing VMware Tools in Linux and Solaris systems requires you to use a command-line program, as described in "Installing and Upgrading VMware Tools" on page 113.

Now that you have created a virtual machine and installed a guest operating system, you can refer to it as you read the rest of the sections in this chapter.

If you did not enter the Workstation serial number when you installed the product (an option available on a Windows host), you are prompted to enter it the first time you attempt to power on a virtual machine. The serial number is on the registration card in your package or in the email message confirming your electronic distribution order. Enter your serial number and click **OK**.

The serial number you enter is saved and Workstation does not ask you for it again. For your convenience, Workstation sends the serial number to the VMware Web site when you use certain Web links built into the product (for example, **Help>VMware on the Web>Register Now!** and **Help>VMware on the Web>Request Support**). This allows VMware to direct you to the correct Web page to register and get support for your product.

Introduction to Workstation Preferences

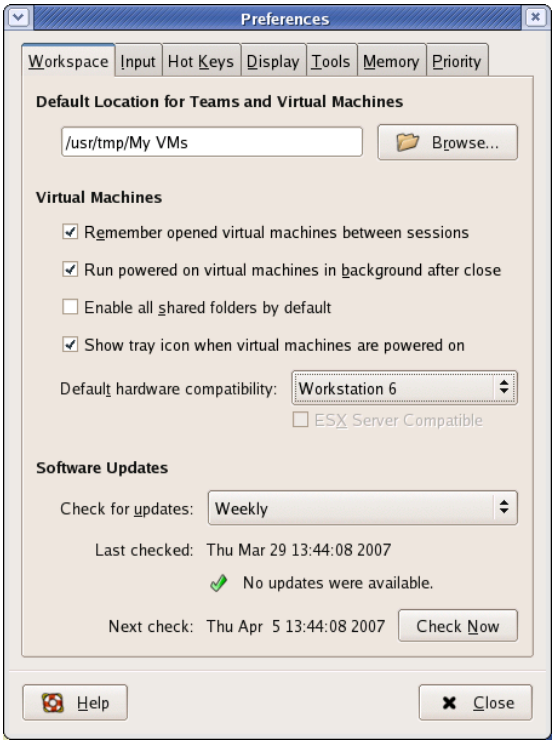
The Preferences dialog box lets you change a number of settings that apply to VMware Workstation itself, no matter which virtual machine you are running.

The default settings for Workstation preferences are correct for most cases. You should not change settings unless you are an experienced user.

NOTE On a Linux host, you must be logged in as root to save global preference changes.

To make changes to these settings, choose **Edit>Preferences**. Figure 4-7 shows an example of the Workstation preferences editor.

Figure 4-7. Preference Editor's Workspace Tab (on a Linux Host)



Following is a list of the tabs in the Preferences dialog box, along with cross-references to the sections of this manual that pertain to each tab:

- **Workspace** tab – Lets you configure the following settings:
  - **Location** section – Lets you change the directory in which newly created virtual machines are stored. See "Virtual Machine Location" on page 150 and "Files That Make Up a Virtual Machine" on page 108.
  - **Virtual Machines** section – Several of these options have to do with exiting Workstation while leaving some virtual machines powered on. See "Closing Virtual Machines and Exiting Workstation" on page 84. For information about enabling shared folders, see "Using Shared Folders" on page 171.
  - **Software Updates** section – See "Checking for Product Updates" on page 76.
- **Input** tab – Lets you adjust the way the virtual machine captures control of keyboard and mouse. For example, by default the virtual machine grabs keyboard and mouse input when you click inside the virtual machine.
- **Hot Keys** tab – Lets you specify the key combination that is used with hot-key sequences for all your virtual machines. Use hot-key sequences to enter and leave full screen mode, ungrab mouse and keyboard input, and so on.
- **Display** tab – Lets you adjust the manner in which the console and the host display accommodate a different guest operating system display resolution.

  Also see "Fitting the Workstation Console to the Virtual Machine Display" on page 163 and "Using Full Screen Mode" on page 156.
- **Memory** tab – For details on adjusting memory settings in VMware Workstation, see "Memory" on page 372. On Linux, you must be running Workstation as root in order to change the settings on the **Memory** tab of the preferences editor.
- **Priority** tab – For information about the snapshot settings on this tab, see "Enabling Snapshot Actions as a Background Activity" on page 229. On Linux, you must be running Workstation as root in order to change this setting.

  For information about the process priority settings available on Windows hosts, see "Configuring Process Scheduling on Windows Hosts" on page 371.
- **Lockout** tab – (Windows hosts only) Lets you restrict who can create new virtual machines, edit virtual machine configurations, and change networking settings. For details, see "Locking Out Interface Features (Windows Hosts Only)" on page 389.

- **Tools** tab – Lets you specify whether you want to automatically upgrade VMware Tools on Windows and Linux guest systems when a new version becomes available. On Linux hosts, you must be running Workstation as root in order to change the settings on the **Tools** tab of the preferences editor.

  VMware Tools is a suite of utilities that enhances the performance of the virtual machine's guest operating system and improves management of the virtual machine by Workstation. See Chapter 6, "Installing and Using VMware Tools," on page 111.

- **Devices** tab – (Windows hosts only) By default, the autorun feature mentioned on this tab is disabled by default. Therefore, you need to manually connect to the CD-ROM drive by using the **VM>Removable Devices** menu, as described in "Connecting and Disconnecting Removable Devices" on page 180.

In addition to the cross-references mentioned in this list, more information about the settings on each tab is available in the Workstation online help. Click the **Help** button in the Preferences dialog box.

The settings on the following tabs apply only to the user currently logged on to the host computer: **Workspace** tab, **Input** tab, **Hot Keys** tab, **Priority** tab, and **Tools** tab.

The settings on the following tabs apply no matter which virtual machine is running or which user is logged on to the host computer: **Display** tab, **Memory** tab, **Lockout** tab, and **Devices** tab.

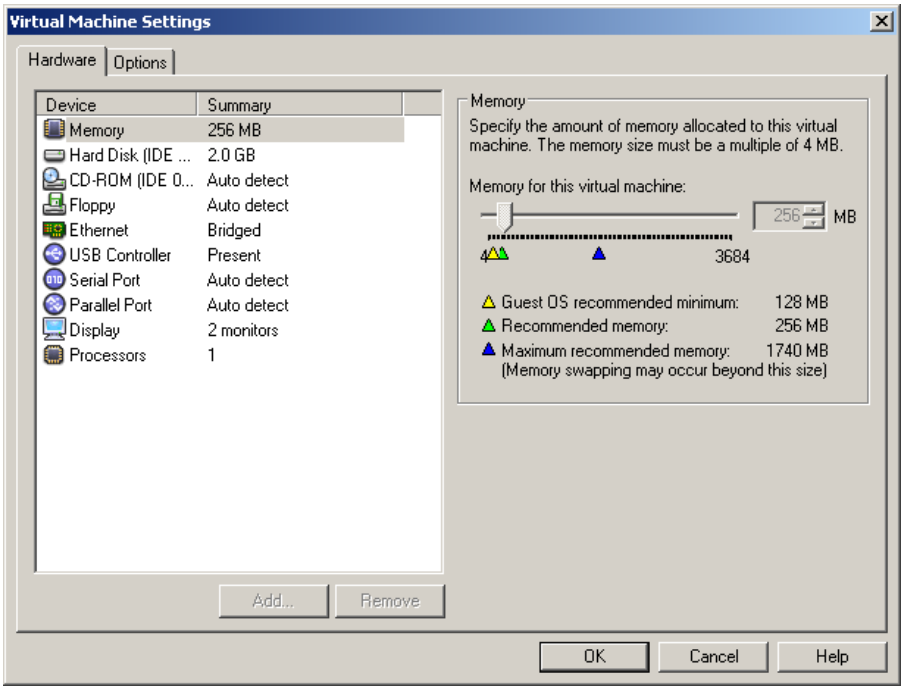
Introduction to Virtual Machine Settings

Workstation configures a new virtual machine based on the guest operating system you select in the New Virtual Machine wizard. After the virtual machine is created, you can use the virtual machine settings editor (**VM>Settings**) to change any configuration options set by the wizard.

Hardware Tab

Use the **Hardware** tab to add, remove, and configure virtual devices for the selected virtual machine. To add and remove hardware, and to change many of the configuration settings, you need to power off (but not close) the virtual machine before displaying this dialog box.

Figure 4-8. Virtual Machine Settings Hardware Tab



When you select an item in the hardware list, the options that correspond to the item are displayed on the right side of the dialog box. For example, in Figure 4-8, memory options are displayed because the **Memory** item is selected.

Topics and chapters related to each of the virtual devices in the **Hardware** list are provided later in this manual. To display online help for an item you select in the **Hardware** list, click the **Help** button.

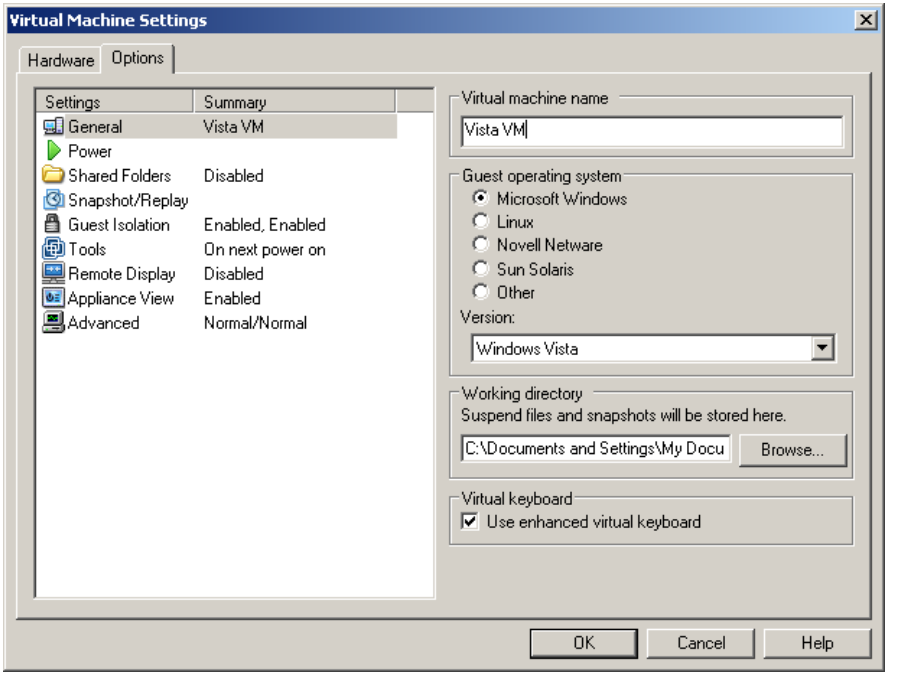
Options Tab

The **Options** tab lets you adjust characteristics of the selected virtual machine:

- Many options control interactions between the host and the guest operating system, such as how folders can be shared, how files are transferred, and what happens to a guest operating system when you exit Workstation.
- Some options let you override similar Preferences dialog box options, which are global preferences set for all virtual machines. For example, you can use the **Advanced** option to override the process priorities set on the **Priority** tab in the Preferences dialog box.

- Some options let you change settings you might initially make when running the New Virtual Machine wizard to create a virtual machine. For example, you can use the **General** options to change the name of the virtual machine.

Figure 4-9. Virtual Machine Settings Options Tab



The settings for the virtual machine **Options** tab are discussed later in this manual, in the task-specific topics and procedures where you would use them. To display online help for an item you select in the **Options** list, click the **Help** button.

Closing Virtual Machines and Exiting Workstation

When you close a virtual machine or team, and when you exit Workstation, if any virtual machines are still powered on, you are prompted to specify one of the following actions to take:

- Continue running the virtual machine in the background. If a virtual machine continues running after you exit Workstation, you can still interact with it through VNC or some other service.
- Suspend the virtual machine. The suspend operation saves the state of the virtual machine. For more information, see "Using the Suspend and Resume Features" on page 223.
- Power the virtual machine off. If you have configured the power operation to do a "soft" power-off, a VMware Tools script runs in order to cleanly shut down the guest operating system before powering off. For more information, see "Powering Off Versus Shutting Down and Resetting Versus Restarting" on page 152.

If you don't want to receive a prompt every time you exit Workstation or close a virtual machine or team, you can set a preference to specify that you want virtual machines to always run in the background when you exit.

To set virtual machines to run in the background

Do one of the following:

- Respond to the prompt when you close the virtual machine or exit Workstation, as follows: Click **Run in Background**.
- Set a Workstation preference:

  a From the VMware Workstation menu bar, choose **Edit>Preferences**.

  b On the **Workspace** tab, select **Run powered on virtual machines in background after close** and click **OK**.

  Virtual machines will run in the background when you close a tab or exit Workstation. You will no longer be prompted.

By default, when virtual machines run in the background, a status icon is displayed in the notification area of the taskbar. Place your mouse pointer over the icon to display a a tooltip that shows the number of virtual machines and teams that are running in the background. These are the virtual machines and teams that belong to the logged in user.

Keyboard Shortcuts

If you prefer to work from the keyboard, use the keyboard shortcuts shown in Table 4-1. If you changed the Preferences setting for the hot-key combination, substitute your new setting for Ctrl+Alt as needed in the shortcuts listed in Table 4-1.

Table 4-1. Keyboard Shortcuts

Shortcut	Action
Ctrl+B	Power on.
Ctrl+E	Power off.
Ctrl+R	Reset the power.
Ctrl+Z	Suspend.
Ctrl+N	Create a new virtual machine.
Ctrl+O	Open a virtual machine.
Ctrl+F4	Close the summary/console view for the selected virtual machine. A confirmation dialog appears only if the virtual machine is powered on.
Ctrl+D	Edit the virtual machine's configuration.
F9	Toggle between displaying and hiding the sidebar.
Ctrl+G	Grab input from keyboard and mouse.
Ctrl+P	Edit preferences.
Ctrl+Alt+Enter	Toggle between full screen mode and windowed mode.
Ctrl+Alt	Release the mouse cursor. If the virtual machine is in the type of full screen mode called exclusive mode, pressing Ctrl+Alt brings the virtual machine out of exclusive mode and into full screen mode.
Ctrl+Alt+Tab	Switch among open virtual machines while mouse and keyboard input are grabbed.
Ctrl+Tab	Switch among open virtual machines while mouse and keyboard input are not grabbed. VMware Workstation must be the active application.
Ctrl+Shift+Tab	Switch among open virtual machines while mouse and keyboard input are not grabbed. VMware Workstation must be the active application.
Ctrl+Shift+right arrow	In full screen mode, switch to the next powered-on virtual machine.
Ctrl+Shift+left arrow	In full screen mode, switch to the previous powered-on virtual machine.

Creating a New Virtual Machine

5

This chapter discusses how to create a new virtual machine and install a guest operating system. This chapter contains the following topics:

- "Setting Up a New Virtual Machine" on page 87
- "Installing a Guest Operating System" on page 95
- "Importing Virtual Machines from Other Formats (Windows Hosts Only)" on page 98
- "Files That Make Up a Virtual Machine" on page 108

Setting Up a New Virtual Machine

This section describes how to create a new virtual machine from scratch. If instead, you would like to create a virtual machine from a system image or from a virtual machine from a third party, see "Importing Virtual Machines from Other Formats (Windows Hosts Only)" on page 98.

Before You Begin

As you complete the New Virtual Machine wizard, you are prompted to make decisions about many aspects of the virtual machine. This section provides information about the issues involved so that you can determine which choices you want to make before running the wizard.

Typical Versus Custom Configurations

As with many types of installation wizards, the New Virtual Machine wizard prompts you to choose between doing a typical or custom installation. If you select **Typical**, the wizard prompts you to specify or accept defaults for the following choices:

- The guest operating system. For information, see "Guest Operating System Selection" on page 89.
- The virtual machine name and the location of the virtual machine's files. For information, see "Virtual Machine Location" on page 89.
- The network connection type. For information, see "Network Connection Type" on page 90.
- Whether to allocate all the space for a virtual disk at the time you create it. For information, see "Disk Capacity" on page 92.
- Whether to split a virtual disk into 2GB files. For information, see "Disk Capacity" on page 92.

You are *not* prompted to specify the virtual machine version. The virtual machine version (Workstation 4, 5, or 6) is assumed to be the one specified in the preferences editor (from the Workstation menu bar, choose **Edit>Preferences**, and see the setting for **Default hardware compatibility**).

Many circumstances can cause you to select a custom installation. Select **Custom** if you want to:

- Make a different version of virtual machine than what is specified in the preferences editor (from the Workstation menu bar, choose **Edit>Preferences**, and see the setting for **Default hardware compatibility**).
- Specify whether you want to create an IDE or a SCSI virtual disk, regardless of the default that is usually used for the guest operating system.

  In order to find out what type of virtual disk would be created by default for a particular operating system, select the **Custom** option and click **Next** through the wizard pages, select the desired guest operating system, and then continue through the wizard until you get to the page called Select a Disk Type. The default is already selected.
- Use a physical disk rather than a virtual disk (for expert users). This topic is discussed in "Virtual Disks and Physical Disks" on page 92.
- Use an existing virtual disk rather than create a new virtual disk. This topic is discussed in "Virtual Disks and Physical Disks" on page 92.
- Set memory options that are different from the defaults.

- Assign more than one virtual processor to the virtual machine. This topic is discussed in "Number of Processors" on page 90.
- Create a virtual machine for end users. This topic is discussed in "Using Full Screen Switch Mode" on page 393.

Guest Operating System Selection

The wizard prompts you to specify which type of operating system you plan to install in the guest. Examples include Windows 2000 Professional, Red Hat Linux 4, and Ubuntu 64-bit. Workstation uses this information to:

- Select appropriate default values, such as the amount of memory needed
- Name files associated with the virtual machine
- Adjust settings for optimal performance
- Work around special behaviors and bugs within a guest operating system

Do not attempt to install a 64-bit operating system after selecting a 32-bit guest operating system type here.

If the operating system you plan to use is not listed, select **Other** for both guest operating system and version.

NOTE Workstation supports 64-bit guest operating systems only in Workstation versions 5.5 and later, and only on host machines with supported processors. For the list of processors Workstation supports for 64-bit guest operating systems, see the *VMware Guest Operating System Installation Guide*, available from the **Help** menu.

Virtual Machine Location

The following examples show the default locations suggested for virtual machines.

- **Windows hosts:** On Windows 2000, Windows XP, and Windows Server 2003, the default folder for a Windows XP Professional virtual machine is:

  ```
  C:\Documents and Settings\<username>\My Documents\My Virtual
  Machines\Windows XP Professional
  ```

  On Windows Vista, the default folder is:

  ```
  C:\Users\<username>\Documents\Virtual Machines\Windows XP Professional
  ```

- **Linux hosts:** The default location for a Windows XP Professional virtual machine is `<homedir>/vmware/Windows XP Professional`, where `<homedir>` is the home directory of the user who is currently logged on.

Virtual machine performance might be slower if your virtual hard disk is on a network drive. For best performance, be sure the virtual machine's folder is on a local drive.

However, if other users need to access this virtual machine, you should consider placing the virtual machine files in a location that is accessible to them. For more information, see "Sharing Virtual Machines with Other Users" on page 191.

Number of Processors

This option is available for custom configurations only. Setting the virtual machine to have two processors is supported only for host machines with at least two logical processors. (If you are creating a version 4 virtual machine, you will not see this panel.)

The following are all considered to have two logical processors:

- A single-processor host with hyperthreading enabled
- A single-processor host with a dual-core CPU
- A multiprocessor host with two CPUs, regardless of whether they are dual-core or have hyperthreading enabled

For more about Workstation support for virtual Symmetric Multiprocessing (SMP), see "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 365.

Network Connection Type

You have several options:

- **Bridged networking** – If your host computer is on a network and you have a separate IP address for your virtual machine (or can get one automatically from a DHCP server), select **Use bridged networking**. Other computers on the network can then communicate directly with the virtual machine.
- **NAT** – If you do not have a separate IP address for your virtual machine but you want to be able to connect to the Internet, select **Use network address translation (NAT)**. The virtual machine and the host share a single network identity that is not visible outside the network.
- **Host-only** – Host-only networking provides a network connection between the virtual machine and the host computer, using a virtual Ethernet adapter that is visible to the host operating system. With host-only networking, the virtual machine can communicate only with the host and other virtual machines in the host-only network. This approach can be useful if you need to set up an isolated virtual network.
- **No connection** – You can always set up a connection after you finish creating the virtual machine.

  For more details about Workstation networking options, see "Configuring a Virtual Network" on page 271.

SCSI Adapter Types

This option is available for custom configurations only. An IDE and a SCSI adapter are installed in the virtual machine. The IDE adapter is always ATAPI. For the SCSI adapter, you can choose BusLogic or LSI Logic. The default for your guest operating system is already selected. All guests except for Windows Vista, Windows Server 2003, Red Hat Enterprise Linux 3, and NetWare default to the BusLogic adapter. For Windows Vista guests, your only choice is LSI Logic.

NOTE The LSI Logic adapter has improved performance and works better with generic SCSI devices. The LSI Logic adapter is also supported by ESX Server 2.0 and higher. Keep this in mind if you plan to migrate the virtual machine to another VMware product.

Your choice of SCSI adapter does not affect your decision to make your virtual disk an IDE or SCSI disk. However, some guest operating systems, such as 32-bit Windows XP, do not include a driver for the Buslogic or LSI Logic adapter. You must download the driver from the LSI Logic Web site.

NOTE Drivers for a Mylex (BusLogic) compatible host bus adapter are not obvious on the LSI Logic Web site. Search the support area for the numeric string in the model number. For example, search for "958" for BT/KT-958 drivers.

See the *VMware Guest Operating System Installation Guide* for details about the driver and the guest operating system you plan to install in this virtual machine.

Disk Modes: Normal or Independent

This option is available on Linux hosts for custom configurations only. The default, normal mode is to include disks in any snapshots you take. You can change this behavior, however. If you do not want data on the disk to be recorded when you take a snapshot of the virtual machine, you can configure the disk to be independent. For more information, see "Using Snapshots" on page 225.

If you configure the disk to be independent, you can further specify whether changes you make to the disk should persist or be discarded when you power off the virtual machine or restore it to a snapshot.

On Linux hosts, you can specify these settings in the New Virtual Machine wizard, on the Select a Disk Type page, in the **Mode** section. On Windows hosts, you can use the virtual machine settings editor. After you create the virtual machine, select it and from the Workstation menu bar, choose **VM>Settings>Hardware>Hard Disk>Advanced**.

Virtual Disks and Physical Disks

This option is available for custom configurations only. If you use a typical configuration, a new virtual disk is created and used for the virtual machine. Virtual disks are the best choice for most virtual machines. They are quick and easy to set up and can be moved to new locations on the same host computer or to different host computers.

Even for custom configurations, you usually choose the option **Create a New Virtual Disk**, though in some cases you might want to choose **Use an Existing Virtual Disk**, to use a virtual disk you have created previously. In this case, the wizard displays a page for you to enter the path or browse to the existing virtual disk (`.vmdk`) file.

To use a physical hard disk (a "raw" disk) or IDE disk partition, see"Using Physical Disks in a Virtual Machine" on page 205. VMware recommends that you do not use a physical disk configuration unless you are an expert user.

Disk Capacity

The wizard prompts you to set a size between 0.1GB and 950GB for a SCSI virtual disk. You then choose whether to allocate all the disk space now or allow the virtual machine to grow as you use it. It is recommended that you allow the disk to grow.

The option **Allocate all disk space now** gives somewhat better performance for your virtual machine. If you allocate all the disk now, you will not be able to use the shrink disk feature later.

NOTE Allocating all disk space now is a time-consuming operation that cannot be canceled, and requires as much physical disk space as you specify for the virtual disk.

You are also given the option **Split disk into 2GB files**. Select this option if your virtual disk is stored on a file system that does not support files larger than 2GB.

Using the New Virtual Machine Wizard

The New Virtual Machine wizard guides you through the key steps for setting up a new virtual machine, helping you set various options and parameters. You can then use the virtual machine settings editor (from the menu bar, choose **VM>Settings)** if you need to make any changes to your virtual machine's setup.

This section includes the following procedures:

- "To create a virtual machine by using the typical setup" on page 93
- "To create a virtual machine by using the custom setup" on page 93

If you need assistance in determining which type of setup to use, see "Typical Versus Custom Configurations" on page 88.

To create a virtual machine by using the typical setup

1 Start VMware Workstation.

For instructions, see "Starting Workstation" on page 64.

2 Choose **File>New>Virtual Machine**, to start the New Virtual Machine wizard and click **Next**.

3 In the Select the Appropriate Configuration page, select **Typical** and click **Next**.

4 On the Select a Guest Operating System page, select the operating system (including the version) that you intend to install in the new virtual machine and click **Next**.

For more information, see "Guest Operating System Selection" on page 89.

5 On the Name the Virtual Machine page, select a name and folder for the virtual machine and click **Next**.

The name you enter here is used if you add this virtual machine to the VMware Workstation **Favorites** list. This name is also used as the name of the folder where all the files associated with this virtual machine are stored.

Each virtual machine should have its own folder. For more information, see "Virtual Machine Location" on page 89.

6 On the Network Type page, configure the networking capabilities of the virtual machine and click **Next**.

For more information, see "Network Connection Type" on page 90.

7 On the Specify Disk Capacity page, enter the size of the virtual disk, specify the way you want the disk space allocated, and click **Finish**.

For more information, see "Disk Capacity" on page 92.

Now that the virtual machine is created, continue on with "Installing a Guest Operating System" on page 95.

To create a virtual machine by using the custom setup

1 Start VMware Workstation.

For instructions, see "Starting Workstation" on page 64.

2 Choose **File>New>Virtual Machine**, to start the New Virtual Machine wizard and click **Next**.

3 In the Select the Appropriate Configuration page, select **Custom** and click **Next**.

4 On the Choose the Virtual Machine Hardware Compatibility page, specify whether you want to create a Workstation 4, 5, or 6 virtual machine and click **Next**.

When you make a selection from the **Hardware Compatibility** list, you will see a list of other VMware products and versions that are compatible with your selection. You will also see a list of features that will not be available for that version.

5 On the Select a Guest Operating System page, select the operating system (including the version) that you intend to install in the new virtual machine and click **Next**.

For more information, see "Guest Operating System Selection" on page 89.

6 On the Name the Virtual Machine page, select a name and folder for the virtual machine and click **Next**.

The name you enter here is used if you add this virtual machine to the VMware Workstation **Favorites** list. This name is also used as the name of the folder where all the files associated with this virtual machine are stored.

Each virtual machine should have its own folder. For more information, see "Virtual Machine Location" on page 89.

7 If you are creating a Workstation 5 or 6 virtual machine, on the Processor Configuration page, select the number of processors for the virtual machine and click **Next**.

For more information, see "Number of Processors" on page 90.

8 On the Memory for the Virtual Machine page, either adjust the memory settings or accept the default setting and click **Next**.

In most cases, it is best to keep the default memory setting. If you plan to use the virtual machine to run many applications or applications that need large amounts of memory, you might want to use a higher memory setting. For more information, see "Setting the Memory Size of a Virtual Machine" on page 372.

NOTE You cannot allocate more than 2GB of memory to a virtual machine if the virtual machine's files are stored on a file system such as Windows 9.x and ME with FAT16 that does not support files greater than 2GB.

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9 On the Network Type page, configure the networking capabilities of the virtual machine and click **Next**.

For more information, see "Network Connection Type" on page 90.

10 On the Select I/O Adapter Types page, select the type of SCSI adapter you want to use with the virtual machine and click **Next**.

For more information, see "SCSI Adapter Types" on page 91.

11 On the Select a Disk page, select whether to create an IDE or SCSI disk and click **Next**.

For more information, see "Virtual Disks and Physical Disks" on page 92.

12 On the Select a Disk Type page, select whether to create an IDE or SCSI disk and click **Next**.

The wizard recommends the best choice based on the guest operating system you selected. All Linux distributions you can select in the wizard use SCSI virtual disks by default, as do several newer Windows operating systems and 64-bit operating systems.

13 (Linux hosts only) Also on the Select a Disk Type page, if you want to exclude disks from snapshots, in the **Mode** section, select **Independent** for the mode and choose one of the following options:

- **Persistent** – Changes are immediately and permanently written to the disk.
- **Nonpersistent** – Changes to the disk are discarded when you power off or revert to a snapshot.

For more information, see "Using Snapshots" on page 225.

14 On the Specify Disk Capacity page, enter the size of the virtual disk, specify the way you want the disk space allocated, and click **Next**.

For more information, see "Disk Capacity" on page 92.

15 On the Specify Disk File page, enter the location of the virtual disk's files and click **Finish**.

The wizard sets up the files needed for your virtual machine.

Now that the virtual machine is created, continue on with "Installing a Guest Operating System" on page 95.

Installing a Guest Operating System

A new virtual machine is like a physical computer with a blank hard disk. Before you can use it, you need to partition and format the virtual disk and install an operating system. The operating system's installation program might handle the partitioning and formatting steps for you.

Installing a guest operating system inside your VMware Workstation virtual machine is essentially the same as installing it on a physical computer.

To install a guest operating system

1 Start VMware Workstation.

2 Insert the installation CD-ROM or floppy disk for your guest operating system.

In some host configurations, the virtual machine cannot boot from the installation CD-ROM. You can work around that problem by creating an ISO image file from the installation CD-ROM. Use the virtual machine settings editor (choose **VM>Settings**) to connect the virtual machine's CD drive to the ISO image file, and power on the virtual machine.

3 If the operating system spans several CDs, when you are prompted to insert the second CD:

a Disconnect from the current image by choosing **VM>Removable Devices>CD-ROM>Disconnect**.

b Edit the CD settings by choosing **VM>Removable Devices>CD-ROM>Edit**.

c For **Use ISO image file**, click **Browse**, and select the ISO image for the second CD.

d In the **Device Status** area, select the **Connected** check box and click **OK**.

e In the guest operating system, click **OK** or otherwise respond to the prompt so that installation can continue. Repeat this process for additional CDs.

4 Click the **Power On** button to power on your virtual machine.

5 Follow the instructions provided by the operating system vendor.

The next section provides notes on installing a Windows XP guest operating system. The screen shots illustrate the process on a Windows host. The steps are the same on a Linux host.

For information on installing other guest operating systems, see the *VMware Guest Operating System Installation Guide*, available from the VMware Web site or from the **Help** menu.

NOTE Workstation supports 64-bit guest operating systems only in Workstation versions 5.5 and later, and only on host machines with supported processors. For the list of processors Workstation supports for 64-bit guest operating systems, see the *VMware Guest Operating System Installation Guide*.

Example: Installing Windows XP as a Guest Operating System

You can install Windows XP Home Edition or Windows XP Professional in a virtual machine using the full installation CD.

Before installing the operating system, make sure that you have already created a new virtual machine and configured it using the New Virtual Machine wizard. See "Setting Up a New Virtual Machine" on page 87.

NOTE To use SCSI disks in a 32-bit Windows XP virtual machine, you need a special SCSI driver available from the download section of the VMware Web site. Follow the instructions on the Web site to use the driver with a fresh installation of Windows XP.

To install Windows XP as a guest operating system

1 Do one of the following to access the installation media for the guest operating system:

- Configure the virtual machine to use the host's CD-ROM drive, and insert the Windows XP CD in the CD-ROM drive. See "Adding DVD or CD Drives to a Virtual Machine" on page 211.
- Connect to an ISO image of an installation disk. See "Connecting a CD-ROM/DVD or Floppy Drive to an Image File" on page 213.

NOTE If you plan to use a PXE server to install the guest operating system over a network connection, you do not need the operating system installation media. When you power on the virtual machine in the next step, the virtual machine detects the PXE server.

2 Power on the virtual machine to start installing Windows XP.

3 Follow the Windows XP installation steps as you would for a physical computer.

4 When the installer is finished, you have a virtual machine running Windows XP.

5 Install VMware Tools, as described in "Installing and Upgrading VMware Tools" on page 113.

Upgrading a Guest Operating System

When you use the New Virtual Machine wizard to create a virtual machine, one of the settings you specify is the guest operating system type and version. Workstation chooses configuration defaults based on the guest type and version you choose.

If you upgrade a guest operating system to a newer version, also update the guest operating system version for the virtual machine.

To upgrade a guest operating system

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 From the Workstation menu bar, choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Options**.

The **General** option is selected by default.

4 From the **Version** field, select the version that you plan to upgrade to and click **OK**.

The setting you specify here is written to the virtual machine's configuration file. This setting does not actually change the guest operating system itself.

5 Power on the virtual machine.

6 Follow the upgrade instructions provided by the operating system vendor.

Configuring the Guest Operating System

After the guest operating system is installed, you can use the standard tools within the operating system to configure its settings.

Importing Virtual Machines from Other Formats (Windows Hosts Only)

Workstation 6 incorporates the Converter Import wizard from the VMware Converter product. Using the Converter Import wizard to perform a conversion to VMware virtual machines enables you to:

- Avoid reinstalling operating systems and applications for system configurations you use often.
- Overcome legacy migration barriers. Certain legacy systems might be impossible to recreate through reinstallation.
- Convert a physical machine into a virtual machine.
- Use virtual machines or system images created with products from other companies such as Norton, Symantec, and StorageCraft.

Summary of the Conversion Process

Workstation provides two ways to convert a virtual machine or system image:

- Use the **File>Open** to convert and open a virtual machine or system image quickly. Workstation uses default settings to make the conversion automatically, with no input required from you. The original Microsoft Virtual PC, Symantec Backup Exec System Recovery, or StorageCraft configuration (`.vmc`, `.spf`, or `.sv2i`) file is unchanged. The **File>Open** command creates a linked clone when it opens the file.

  If you attempt to open a virtual machine or system image that is password-protected, you will be prompted to use the Converter Import wizard.

- Use the **File>Import** command to specify a number of options for the converted virtual machine: the converted virtual machine's location, whether or not the converted virtual machine shares virtual disks with the original virtual machine or system image, and whether the converted virtual machine is to be compatible with Workstation 4.x, 5.x, or 6.x; ESX 2.x or 3.x; GSX Server 3.x; or VMware ACE 1.x or 2.

Detailed procedures are provided in "Opening and Importing a Virtual Machine or System Image" on page 106.

The wizard outputs a completely new VMware virtual machine based on the input virtual machine or system image. The newly migrated VMware virtual machine retains the configuration of the original virtual machine or image.

The migration process is non-destructive, so you can continue to use the original virtual machine with Microsoft Virtual PC, or the original system image with Symantec Backup Exec System Recovery. However, if you plan to run a new VMware virtual machine on the same network as the original Virtual PC virtual machine, you must modify the network name and IP address on one of the virtual machines, so the original and new virtual machines can coexist.

This section includes the following topics:

- "VMware Converter Versus the Importer Wizard in Workstation" on page 100
- "Converter Import Wizard: Overview and Supported Source Machines" on page 100
- "Supported Destinations" on page 103
- "How Converting Affects Settings" on page 105
- "Opening and Importing a Virtual Machine or System Image" on page 106

VMware Converter Versus the Importer Wizard in Workstation

As was mentioned previously, Workstation 6 incorporates the Converter Import wizard from the VMware Converter product. VMware Converter is a separate downloadable application for Windows hosts that provides an easy-to-use, scalable solution for migrations of machines, both physical to virtual and virtual to virtual. In addition to the Converter Import wizard, VMware Converter provides a task manager, which lets you schedule migrations of many machines.

The Converter Import wizard included with Workstation enables you to create VMware virtual machines from a local or remote physical machine or from virtual machines and system images that were originally created by using other products than VMware products. You can also use the wizard to change a virtual machine using one VMware format to that using another. For example, you can copy a VMware Server virtual machine and use it to create an ESX virtual machine.

This Converter Import wizard functionality is included with Workstation, but to use other features of VMware Converter, such as its task manager, or the ability to import more than one virtual machine at a time, you need to download the VMware Converter.

Converter Import Wizard: Overview and Supported Source Machines

The VMware Converter Import wizard in Workstation allows you to import the following types of physical and virtual machines:

- Physical machines:
  - Windows NT SP6+ (with Internet Explorer 5 or higher)
  - Windows 2000
  - Windows 2003 32-bit and 64-bit
  - Windows XP Professional 32-bit and 64-bit

NOTE The VMware Converter Import wizard included with Workstation does not convert Windows Vista physical machines to virtual machines. It also does not support converting Windows Vista images.

- VMware virtual machines (`.vmx` and `.vmtn` files):
  - Workstation 4.x, 5.x, and 6.x
  - VMware Player 1.x and 2.x
  - ESX Server 3.x
  - ESX Server 2.5.x (if the virtual machine is managed with VirtualCenter 2.x)
  - GSX Server 3.x
  - VMware Server 1.x
  - VirtualCenter 2.x

  Virtual machines must be powered off before you attempt the migration process. Suspended virtual machines cannot be migrated.

- Other virtual machines and system images:
  - StorageCraft images (`.spf` files)
  - Microsoft Virtual PC 7.x and higher (`.vmc` files)
  - Any version of Microsoft Virtual Server (`.vmc` files)
  - Symantec Backup Exec System Recovery—formerly LiveState Recovery (`.sv2i` files)
  - Norton Ghost images 9.x and higher (`.sv2i` files)

  The operating system on the source Microsoft Virtual PC or Virtual Server virtual machine must be a Windows guest operating system—but not Windows 9x—supported by the intended VMware platform (for example, Workstation 4, 5, or 6). See the VMware Web site for a list of supported operating systems: www.vmware.com/support/guestnotes/doc/index.html.

NOTE Virtual machines from Macintosh versions of Virtual PC are not supported.

Required Information When Importing from Various Source Types

This section details some considerations you need to take into account, and decisions you need to make, before you use the Converter Import wizard.

When the Source Is a Physical Machine

To import a remote machine, you are prompted to supply the computer name or IP address and the user name and password for logging on to the machine with administrative privileges. The user name needs to be in the form `<DOMAIN>\<user name>`.

NOTE Remote physical machines cannot be imported into an ESX-compatible format by the wizard at this time.

When the Source Is an NT Virtual Machine

If the source virtual machine is Windows NT SMP, the wizard might require files from service packs or hot fixes. The wizard shows which files it requires. You will need to browse to the required files. They can be on a disk, your local system, or the network.

On Windows NT machines, during the import process, a snapshot driver is downloaded to the machine. This driver handles the copying and moving of files and registry settings. The driver requires a reboot to complete its tasks. When it is finished, the driver is uninstalled.

When the Source Is an ESX Virtual Machine

You will need to supply the name of the ESX server and the user name and password for logging in.

Password-Protected Virtual Machines

If the virtual machine you want to import is password-protected, you will need to supply the password.

About Page Files and Hibernation Files

You have the option of importing all the disks for the physical or virtual machine, or to save space, you can select some of the volumes and leave out others. If you select specific volumes, you can also ignore the page and hibernation files. These files are large and, for volume-based cloning, do not provide information that you need to copy.

Types of Volumes Supported

Some types of source volumes are unsupported and are skipped during cloning. Virtual machine importing supports basic volumes and all types of dynamic volumes except RAID. It doesn't support Windows NT 4 fault-tolerant volumes. Only Master Boot Record (MBR) disks are supported. GUID Partition Table (GPT) disks are not supported.

Disk Space Allocation

As is the case when you use the New Virtual Machine wizard, you need to specify whether to allocate all the space at creation time or allow the files to grow. Allocating space at creation time gives better performance but is a time-consuming process. It is recommended that you allow the disk to grow.

Select the option **Split disk into 2GB files** if your virtual disk is stored on a file system that does not support files larger than 2GB.

Full Versus Linked Clones

If the source is a virtual machine, you can create a full or linked clone. Creating a full clone implies that you want to use all volumes. Therefore you need to select **Import all disks and maintain size** to create a full clone.

Linked clones can be created from VMware virtual machines, Symantec Backup Exec System Recovery virtual machines(`.sv2i` files), Microsoft Virtual PC and Virtual Server virtual machines, and StorageCraft files (`.spf` files). For VMware virtual machines, to create a linked clone, the virtual hardware version of the destination machine cannot be higher than the hardware version of the source.

WARNING For linked clones, the virtual machine created by the importer will become corrupted if the source is modified after the import. This is true for linked clones imported from Virtual PC and Virtual Server machines and from Symantec backup images. In the case of Virtual PC and Virtual Server source virtual machines, simply powering them on in Virtual PC or Virtual Server modifies them.

Supported Destinations

The Converter Import wizard can output virtual machines that are compatible with:

- Workstation 4.x, 5.x, and 6.x
- VMware Player 1.x and 2.x
- ESX Server 3.x (This destination is not supported if you are importing a remote physical machine.)
- ESX Server 2.5.x (This destination is supported only by importing through a VirtualCenter 2.x server that manages the 2.5.x ESX Server.)
- GSX Server 3.x
- VMware Server 1.x
- VirtualCenter 2.x

NOTE Workstation 4 virtual machines are compatible with VMware GSX Server 3.0, ESX Server 2.x, and ACE 1.x.

Required Information When Designating a Destination for the Virtual Machine

This section details some considerations you need to take into account, and decisions you need to make, before you use the Converter Import wizard to specify the destination for the newly created virtual machine.

When the Destination Is an ESX Virtual Machine

You will need to supply the name of the ESX server and the user name and password for logging in.

When the Destination Is a VirtualCenter Virtual Machine

You will need to provide the following information:

- Name of the VirtualCenter server and the user name and password for logging in.
- Name of the folder in the VirtualCenter inventory where you want to store the virtual machine.
- Name of the host, cluster, or resource pool within a host or cluster from which to run the virtual machine. If you select a cluster in manual mode, you will also need to choose a specific host.
- Name of the datastore for the virtual machine's configuration files and disks. Use the advanced setting if you want to distribute the virtual machine's disks over multiple datastores.

Network Adapters

You are prompted to choose from the available networks at the destination location. If you are creating a virtual machine to use with Workstation rather than ESX or Virtual Center, you can find more information about Workstation networking choices in Chapter 13, "Configuring a Virtual Network," on page 271.

Customizations to the Guest Operating System (Optional)

The wizard also lets you make changes to the identity of the virtual machine (such as computer name and security ID), networking information, and so on. For virtual machines that are converted to ESX virtual machines, you can also select to have the wizard install VMware Tools.

Following is a list of the customizations you can make:

- Computer information
  - Computer name – Alphanumeric name of up to 63 characters. Hyphens and underscores are allowed.
  - Security ID (SID) – Optionally, generate a new security ID.
  - Location of Sysprep files – If the wizard can detect the location, the wizard page displays it. Otherwise, you need to supply the location.

- Windows licensing information
  - Product ID – Leave this blank if you like.
  - Windows Server license information – For Microsoft Windows 2000 Server and 2003 Server only.
- Time zone
- Network information
  - Network adapter (interfaces) – You can make changes here. Or, if more than one network adapter has been modified, reset them to the default.
  - DHCP – Choose between using DHCP to obtain IP addresses or entering them manually. You can also use DHCP to obtain a DNS server address or enter it manually.
  - DNS – Enter DNS suffixes and customize their order to specify the order in which a virtual machine should use them to make connections.
  - WINS – Specify primary and secondary WINS addresses.
  - Workgroup or domain – For workgroups, specify the workgroup name (up to 15 characters). For domains, specify the Windows Server domain, along with the appropriate user name and password.

How Converting Affects Settings

The VMware virtual machine created by the Converter Import wizard contains an exact copy of the disk state from your source virtual machine or system image, with the exception of some hardware-dependent drivers and, sometimes, the mapped drive letters.

Settings from the source computer that remain identical include:

- Operating system configuration (computer name, security ID, user accounts, profiles and preferences, and so forth).
- Applications and data files.
- Each disk partition's volume serial number.

Because the target and the source virtual machines or system images have the same identities (name, SID, and so on), running both on the same network can result in conflicts. If you are planning to redeploy the source virtual machine or system image, be aware of this issue and do not run both the source and target images or virtual machines on the same network at the same time.

Alternatively, you can resolve the duplicate ID problem by using additional tools, such as the Windows 2000 System Preparation Tool (Sysprep). For example, if you use the Converter Import to test the viability of running a Virtual PC virtual machine as a VMware virtual machine without first decommissioning the original Virtual PC machine, you need to resolve the duplicate ID problem.

Possible Migration Issues Caused by Hardware Changes

Most migrated applications should function correctly in the VMware virtual machine because their configuration and data files have the same location as the source virtual machine. However, applications might not work if they depend on specific characteristics of the underlying hardware such as the serial number or the device manufacturer.

When troubleshooting after virtual machine migration, consider the following potential hardware changes:

- The CPU model and serial numbers (if activated) can be different after the migration. They correspond to the physical computer hosting the VMware virtual machine.
- The Ethernet adapter can be different (AMD PCNet or VMXnet) with a different MAC address. Each interface's IP address must be individually reconfigured.
- The graphics card can be different (VMware SVGA card).
- The numbers of disks and partitions are the same, but each disk device can have a different model and different manufacturer strings.
- The primary disk controllers can be different from the source machine's controllers.
- Applications might not work if they depend on devices that are not available from within a virtual machine.

Opening and Importing a Virtual Machine or System Image

The previous sections described the settings you need to specify for the conversion and also described the limitations of the two strategies for converting virtual machines. This section provides detailed instructions for using both the **File>Open** command and the **File>Import** command.

To convert a virtual machine or system image using the Open command

1 From the Workstation menu bar, choose **File>Open**.

2 In the **File name** field, browse to and open the configuration (`.vmx`, `.vmc`, `.spf`, or `.sv2i`) file for the virtual machine or system image to convert.

You can use the field **Files of type** to filter the files displayed by file extension.

3 Click **Open**.

Workstation creates a VMware virtual machine, with a VMware configuration file (`.vmx`) for the converted virtual machine or system image. The converted virtual machine links to the virtual disks of the original virtual machine or system image. The original Virtual PC, Symantec Backup Exec System Recovery, or StorageCraft configuration (`.vmc`, `.spf`, or `.sv2i`) file is unchanged.

If you attempt to open a virtual machine or system image that is password-protected, you will be prompted to use the Converter Import wizard.

To convert a virtual machine or system image using the Import command

1 Gather the information you need to complete the Converter Import wizard:

- For a list of the information you will need when you select a source, see "Required Information When Importing from Various Source Types" on page 101.
- For a list of the information you will need when you specify a destination, see "Required Information When Designating a Destination for the Virtual Machine" on page 103.

2 If you are importing a virtual machine, make sure the virtual machine is powered off.

3 From the Workstation menu bar, choose **File>Import** to launch the VMware Converter Import wizard.

4 Complete the wizard pages.

As you proceed through the wizard, the navigation pane, which is on the left side of the wizard, helps you keep track of where you are in the process.

Whenever you get to a new phase or step, a list expands to display the names of the wizard pages included in that step. When you complete an entire step, the next step expands.

If you want to go back to a previous page, you can click its name in the navigation pane.

Files That Make Up a Virtual Machine

You might never need to know the filenames or locations for your virtual machine files. Virtual machine file management is performed by VMware Workstation. You can therefore skip this section.

A virtual machine typically is stored on the host computer in a set of files, usually in a directory created by Workstation for that specific virtual machine.

The key files are listed in Table 5-1 by extension. In these examples, <vmname> is the name of your virtual machine.

Table 5-1. Virtual Machine Files

Extension	File Name	Description
.log	<vmname>.log or vmware.log	Keeps a log of key VMware Workstation activity. This file is useful in troubleshooting. This file is stored in the directory that holds the configuration (.vmx) file of the virtual machine.
.nvram	<vmname>.nvram or nvram	Stores the state of the virtual machine's BIOS.
.vmdk	<vmname>.vmdk	Virtual disk file, which stores the contents of the virtual machine's hard disk drive. A virtual disk is made up of one or more .vmdk files. The virtual machine settings editor shows the name of the first file in the set—the one that contains pointers to the other files in the set. (If you specify that all space should be allocated when you create the disk, these files start at the maximum size and do not grow.) Almost all of a .vmdk file's content is the virtual machine's data, with a small portion allotted to virtual machine overhead. If the virtual machine is connected directly to a physical disk, the .vmdk file stores information about the partitions the virtual machine is allowed to access. Earlier VMware products used the extension .dsk for virtual disk files.

Table 5-1. Virtual Machine Files (Continued)

Extension	File Name	Description
.vmdk Continued	<vmname>-s<###>.vmdk	If you specified that the files can grow, the file names have an s in the file number (for example, Windows XP Professional-s001.vmdk.) If you specified that the virtual disk should be split into 2GB chunks, the number of .vmdk files depends on the size of the virtual disk. As data is added to a virtual disk, the .vmdk files grow, to a maximum of 2GB each.
	<vmname>-f<###>.vmdk	If the disk space is allocated in advance, the names are similar, except that they include an f instead of an s (for example, Windows XP Professional-f001.vmdk).
	<diskname>-<###>.vmdk	A redo-log file, created when a virtual machine has one or more snapshots. This file stores changes made to a virtual disk while the virtual machine is running. There might be more than one such file. The ### indicates a unique suffix added by VMware Workstation to avoid duplicate file names.
.vmem	<uuid>.vmem	The virtual machine's paging file, which backs up the guest main memory on the host file system. This file exists only when the virtual machine is running or if the virtual machine has crashed.
	<snapshot_name_number>.vmem	Each snapshot of a virtual machine that is powered on has an associated .vmem file, which contains the guest's main memory, saved as part of the snapshot.
.vmsd	<vmname>.vmsd	A centralized file for storing information and metadata about snapshots.
.vmsn	<vmname>-Snapshot.vmsn	The snapshot state file, which stores the running state of a virtual machine at the time you take that snapshot.
	<vmname>-Snapshot<###>.vmsn	The file that stores the state of a snapshot.
.vmss	<vmname>.vmss	The suspended state file, which stores the state of a suspended virtual machine. Some earlier VMware products used the extension .std for suspended state files.
.vmtm	<vmname>.vmtm	The configuration file containing team data.

Table 5-1. Virtual Machine Files (Continued)

Extension	File Name	Description
`.vmx`	`<vmname>.vmx`	The primary configuration file, which stores settings chosen in the New Virtual Machine wizard or virtual machine settings editor. If you created the virtual machine under an earlier version of VMware Workstation on a Linux host, this file might have a `.cfg` extension.
`.vmxf`	`<vmname>.vmxf`	A supplemental configuration file for virtual machines that are in a team. Note that the `.vmxf` file remains if a virtual machine is removed from the team.

There can be other files in the directory, some of which are present only while a virtual machine is running. For example, see "Lock Files" on page 196.

Installing and Using VMware Tools

6

This chapter discusses how to install, upgrade, and run VMware Tools. This chapter contains the following sections:

- "About VMware Tools" on page 111
- "Installing and Upgrading VMware Tools" on page 113
- "Uninstalling VMware Tools or Changing Which Modules Are Installed" on page 132
- "VMware Tools Configuration Options" on page 132
- "Customizations to VMware Tools" on page 139

About VMware Tools

VMware Tools is a suite of utilities that enhances the performance of the virtual machine's guest operating system and improves management of the virtual machine. Installing VMware Tools in the guest operating system is vital. Although the guest operating system can run without VMware Tools, you lose important functionality and convenience.

When you install VMware Tools, you install:

- **VMware Tools service.** The program file is called `VMwareService.exe` on Windows guests and `vmware-guestd` on Linux, FreeBSD, and Solaris guests.

  This service performs various duties within the guest operating system:

  - Passes messages from the host operating system to the guest operating system.
  - Executes commands in the operating system to cleanly shut down or restart a Linux, FreeBSD, or Solaris system when you select power operations in Workstation.
  - Sends a heartbeat to a VMware Server, if you use the virtual machine with VMware Server.
  - On Windows guests, grabs and releases the mouse cursor.
  - On Windows guests, fits the guest's screen resolution to the host's and vice versa.
  - Synchronizes the time in the guest operating system with the time in the host operating system.
  - Runs scripts that help automate guest operating system operations. The scripts run when the virtual machine's power state changes.

  The service starts when the guest operating system boots.

  NOTE The VMware Tools service is not installed on NetWare operating systems. Instead, the `vmwtool` program is installed. It synchronizes time and allows you to turn the CPU idler on or off. See "Using the System Console to Configure VMware Tools in a NetWare Guest Operating System" on page 137.

- **A set of VMware device drivers.** These drivers include:

  - SVGA display driver that provides high display resolution and significantly faster overall graphics performance.
  - The `vmxnet` networking driver for some guest operating systems.
  - BusLogic SCSI driver for some guest operating systems.
  - VMware mouse driver.
  - A kernel module for handling shared folders, called `hgfs.sys` on Windows and `vmhgfs` on Linux and Solaris.

- **VMware user process.** The program file is called `VMwareUser.exe` on Windows guests and `vmware-user` on Linux and Solaris guests.

  This service performs the following tasks within the guest operating system:

  - Enables you to copy and paste text between the guest and host operating systems, and copy and paste files between the host operating systems and Windows, Linux, and Solaris guest operating systems.
  - Enables you to drag and drop files between the host operating systems and Windows, Linux, and Solaris guest operating systems.
  - On Linux and Solaris guests, grabs and releases the mouse cursor when the SVGA driver is not installed.
  - On Linux and Solaris guests, fits the guest's screen resolution to the host's.

  NOTE The VMware Tools user process is not installed on NetWare operating systems. Instead, the `vmwtool` program is installed. It controls the grabbing and releasing of the mouse cursor. It also allows you copy and paste text. You cannot drag and drop or copy and paste files between hosts and NetWare guest operating systems.

- **VMware Tools control panel.** The Tools control panel lets you modify settings, shrink virtual disks, and connect and disconnect virtual devices.

Installing and Upgrading VMware Tools

This section describes how to install or upgrade VMware Tools in the guest operating system.

The installers for VMware Tools for Windows, Linux, FreeBSD, Solaris, and NetWare guest operating systems are installed with VMware Workstation as ISO image files. When you choose **VM>Install VMware Tools** from the VMware Workstation menu bar, Workstation temporarily connects the virtual machine's first virtual CD-ROM drive to the correct ISO image file for the guest operating system. You are ready to begin the installation process.

You can use this menu command to either install or upgrade VMware Tools. On Windows and Linux guests, you can also set VMware Tools to perform automatic updates, as described in the next section, "Upgrading VMware Tools" on page 114.

For information about installing VMware Tools, see the appropriate section:

- "Installing VMware Tools on a Windows Guest" on page 116
- "Installing VMware Tools on a Linux Guest" on page 123
- "Installing VMware Tools in a Solaris Guest" on page 127
- "Installing VMware Tools in a FreeBSD Guest" on page 128
- "Installing VMware Tools in a NetWare Virtual Machine" on page 130

Upgrading VMware Tools

Because VMware Tools installers (ISO images) are installed with VMware Workstation, when you update to a new version of Workstation, a check is performed to find out whether a new version of VMware Tools is available. Although you can set Workstation to check regularly for Workstation updates, the guest operating system checks for VMware Tools updates only when you power on a virtual machine. It compares its version of VMware Tools against the version that is installed on the host.

With regards to VMware Tools updates, you have the following options:

- On Windows and Linux guest systems, you can set VMware Tools to update itself when the virtual machine is powered on. In this case, the status bar displays the message, "Installing VMware Tools . . ." when an upgrade is in progress. After the upgrade is complete, if you are logged in to a Windows guest, a restart prompt appears for 30 seconds. If you are not logged in, the operating system restarts without prompting.

  Automatic upgrades work for versions of VMware Tools included in Workstation 5.5 and above (build 29772 and above). Automatic upgrades do not work for versions of VMware Tools included in virtual machines created with VMware Server 1.x.

  NOTE An auto-upgrade check is performed as part of the boot sequence when you power on a virtual machine. If the virtual machine was suspended and you resume it or restore it to a snapshot during the boot sequence before this check occurs, the automatic upgrade will occur as planned.

  If, however, you resume the virtual machine or restore it to a snapshot after the auto-upgrade check occurs, the automatic upgrade will not occur.

- You can specify that no automatic update should occur. In this case, the status bar displays a message when a new version is available. To install the update, use the same procedure that you used for installing VMware Tools the first time. For the platform-specific installation procedure, see "Installing VMware Tools on a Windows Guest" on page 116 or "Installing VMware Tools on a Linux Guest" on page 123.

  NOTE On Windows, you can alternatively open the VMware Tools control panel (click the **VMware Tools** icon in the notification area of the taskbar), and on the **Options** tab, click **Upgrade**.

The default policy is to not perform the upgrade automatically. The following procedures describe how to set autoupgrade options on a per-virtual-machine basis and an a global basis, for all virtual machines configured to use the global setting.

To use global settings for upgrading VMware Tools automatically

1 Start Workstation. If you use a UNIX host, become root (`su -`) and then start Workstation.

   On UNIX systems, non-root users are not allowed to modify the preference setting for VMware Tools upgrades.

2 From the VMware Workstation menu bar, choose **Edit>Preferences** and click the **Tools** tab.

3 Specify which update policy you want to use and click **OK**.

   If you need more information about the options, click **Help** to display the online help for this dialog box.

   NOTE The automatic upgrade feature is available only for Windows and Linux guest operating systems.

4 For each of your virtual machines, do the following:

   a Select the virtual machine.

      The virtual machine can be either powered on or powered off.

   b Choose **VM>Settings**.

      The virtual machine settings editor opens.

   c Click the **Options** tab, and select **Tools**.

   d Select **Use global settings from Edit>Preferences>Tools** and click **OK**.

To set autoupgrade options for VMware Tools on a per-virtual-machine basis

1 Select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Tools**.

4 Select the update option you want to use and click **OK**.

For more information about the options, click **Help** to display the online help.

Installing VMware Tools on a Windows Guest

VMware Tools is supported on all Windows guest operating systems.

The detailed steps for installing VMware Tools depend on the version of Windows you are running. The steps that follow show how to install VMware Tools in a Windows XP guest. Some steps that are automated in newer versions of Windows must be performed manually in Windows 9x and Windows NT, as described in "Additional Steps When Migrating from Old Versions of Windows" on page 117.

If you are running Workstation on a Windows host and your virtual machine has only one CD-ROM drive, the CD-ROM drive must be configured as an IDE or SCSI CD-ROM drive. It cannot be configured as a generic SCSI device.

To add an IDE or SCSI CD-ROM drive, see "Adding, Configuring, and Removing Devices in a Virtual Machine" on page 179. For information about generic SCSI, see "Connecting to a Generic SCSI Device" on page 357.

NOTE If, when you installed the operating system, you connected the virtual machine's CD drive to the ISO image file, you will need to change the connection from the ISO image to auto-detect a physical drive. (With the virtual machine powered off, choose **VM>Settings>CD-ROM>Use physical Drive, Auto Detect**.)

Alternatively, you can automate the installation of VMware Tools in a Windows guest operating system. For information, see "Automating the Installation of VMware Tools in a Windows Guest" on page 120.

To install VMware Tools in a Windows guest operating system

1 Power on the virtual machine.

2 When the guest operating system starts, choose **VM>Install VMware Tools**.

The remaining steps take place inside the virtual machine.

3 Log in to a Windows NT, Windows 2000, Windows XP, Windows Server 2003, or Windows Vista guest operating system as an administrator to install VMware Tools.

Any user can install VMware Tools in a Windows 95, Windows 98, or Windows Me guest operating system.

If you have autorun enabled in your guest operating system (the default setting for Windows operating systems), a dialog box appears after a few seconds. It asks if you want to install VMware Tools.

If autorun is not enabled, the dialog box does not appear automatically. If it doesn't appear, run the VMware Tools installer. Click **Start>Run** and enter **`D:\setup\setup.exe`** where `D:` is your first virtual CD-ROM drive.

4 Click **Yes** to launch the InstallShield wizard.

5 Follow the on-screen instructions:

- On Windows Server 2003, Windows Me, Windows 98 SE, and Windows 98 guests, the SVGA driver is installed, and the guest operating system uses it after it reboots.
- With Windows 2000 and Windows XP guests, you do not have to reboot to use the new driver.

6 Start the VMware Tools control panel and configure VMware Tools, as described in "VMware Tools Configuration Options" on page 132.

You can access VMware Tools through the Windows Control Panel (choose **Start>Settings>Control Panel>VMware Tools**) or by clicking or right-clicking the **VMware Tools** icon, which appears by default in the notification area of the taskbar.

Additional Steps When Migrating from Old Versions of Windows

If you are migrating from VMware GSX Server to Workstation and your guest operating system is Windows NT, Windows Me, Windows 98, or Windows 95, you might need to configure the video driver manually. Instructions appear in Notepad at the end of the installation process. If the Notepad window is hidden, click the **Notepad** button on the Windows taskbar.

See the following steps that correspond to your guest operating system.

To migrate from Windows NT guest operating systems

1 After installing VMware Tools, click **Finish**.

The Display Properties dialog box appears.

2 Click the **Display Type** button.

The Display Type dialog box appears.

3 Click the **Change** button.

The Change Display dialog box appears.

4 Select **VMware, Inc.** from the **Manufacturer** list.

5 Select **VMware SVGA** as the display adapter and click **OK**.

6 Click **Yes** in response to the on-screen question about third-party drivers to install the driver and click **OK** to confirm the drivers were installed.

7 Click **Close** from the Display Type dialog box and click **Close** from the Display Properties dialog box.

8 Click **Yes** to restart Windows NT and start using the new video driver.

9 The VMware Tools background application is launched when you reboot your virtual machine.

To migrate from Windows Me guest operating systems

1 After installing VMware Tools, click **Finish**.

The Display Settings dialog box appears.

2 Click the **Advanced** button.

3 Click the **Adapter** tab.

4 Click the **Change** button, and after the Update Device Driver wizard starts, click **Next**.

5 Choose the option **Specify the location of the driver** and click **Next**.

6 Check the **Specify a location** check box and enter the following path:

```
D:\video\win9x
```

`D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine.

7 Click **OK**. Windows Me locates your driver.

8 Select the **VMware SVGA II** display adapter and click **Next**.

9 Click **Next** to install the driver.

If you are upgrading a virtual machine created under VMware GSX Server 2, you might see a dialog box that warns, "The driver you are installing is not specifically designed for the hardware you have.… Do you wish to continue?" Click **Yes**.

10 After the driver is installed, click **Finish**.

11 Click **Yes** to restart Windows Me and start using the new video driver.

The VMware Tools background application starts when you reboot your virtual machine.

To migrate from Windows 98 guest operating systems

1 After installing VMware Tools, click **Finish**.

The Display Settings dialog box appears.

2 Click the **Advanced** button.

The Standard Display Adapter (VGA) Properties dialog box appears.

If you are upgrading from a previous version of the VMware drivers, this dialog box is titled VMware SVGA Properties.

3 Click the **Adapter** tab.

4 Click the **Change** button, and after the Update Device Driver wizard starts, click **Next**.

5 Choose the option **Display a list of all drivers in a specific location** and click **Next**.

6 Select **Have Disk**.

The Install From Disk dialog box appears.

7 Enter the following path:

```
D:\video\win9x
```

`D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine.

8 Click **OK**.

9 Select **VMware SVGA** display adapter and click **OK**.

10 Answer **Yes** to the on-screen question and click **Next** to install the driver.

11 After the driver is installed, click **Finish**.

12 Click **Close** in the SVGA Properties dialog box and click **Close** in the Display Settings dialog box.

13 Click **Yes** to restart Windows 98 and start using the new video driver.

The VMware Tools background application starts when you reboot your virtual machine.

To migrate from Windows 95 guest operating systems

1 After installing VMware Tools, click **Finish**.

The Display Settings dialog box appears.

2 Click the **Advanced Properties** button.

The Advanced Display Properties dialog box appears.

3 Click the **Change** button.

The Select Device dialog box appears.

4 Select **Have Disk**.

5 Enter the following path and click **OK**:

```
D:\video\win9x
```

`D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine.

6 Click **OK** again to install the driver.

7 Click **Close** from the Advanced Display Properties dialog box and click **Close** from the Display Setting dialog box.

8 Click **Yes** to restart Windows 95 and start using the new video driver.

The VMware Tools background application starts when you reboot your virtual machine.

Automating the Installation of VMware Tools in a Windows Guest

You can automate the installation of VMware Tools in a Windows guest operating system by using the Microsoft Windows Installer runtime engine to install the software silently (in quiet mode). If you are installing VMware Tools in a number of Windows virtual machines, you might want to use the silent install features.

To install VMware Tools in silent mode

1 Make sure the guest operating system in which you are installing VMware Tools has the Microsoft Windows Installer runtime engine version 2.0 or higher installed.

Version 2.0 or higher is included with newer versions of Windows. If you are installing VMware Tools in older Windows guest operating systems, check the version of this file:

```
%WINDIR%\system32\msiexec.exe
```

2 If you need to upgrade the engine, run `instmsiw.exe` (`instmsia.exe` for Windows 95 or Windows 98 guests), which is included with the VMware Tools installer.

For more information on using the Microsoft Windows Installer: msdn.microsoft.com/library/default.asp?url=/library/en-us/msi/setup/about_windows_installer.asp.

3 Make sure the virtual machine's CD-ROM drive is connected to the VMware Tools ISO image is configured to connect when you power on the virtual machine:

a Select the virtual machine and choose **VM>Settings>Hardware>CD-ROM**.

b In the **Device status** section, select the **Connect at Power On** check box.

c In the **Connection** section, select **Use ISO image** and browse to the `windows.iso` file, located in the directory where you installed Workstation.

d Click **OK**.

4 In the guest operating system, if necessary, suppress prompts about installing unsigned drivers.

The drivers installed by VMware Tools are not signed by Microsoft. When you install VMware Tools, you are asked to confirm the installation of these drivers.

For all Windows systems except Windows Vista:

a On the virtual machine's desktop or **Start** menu, right-click **My Computer**, and choose **Properties**.

b Click the **Hardware** tab and click **Driver Signing**. The Driver Signing dialog box appears.

c Click **Ignore** and click **OK** twice.

For Windows Vista:

a On the **Start** menu, right-click **Computer**, and choose **Properties**.

b Click **Advanced system settings>Hardware>Windows Update driver settings**.

c Click **Never check for drivers when I connect a new device** and click **OK** twice.

5 Run the silent installation on the extracted installation packages.

At the command prompt, if you want to install all the VMware Tools components type:

```
msiexec –i "D:\VMware Tools.msi" ADDLOCAL=ALL /qn
```

You can customize the installation command by using standard Microsoft Windows Installer installation options. If you do not want to install all the VMware Tools components, use the following list to determine which components to install:

- `Toolbox` – VMware Tools control panel and its utilities. Excluding this feature prevents you from using VMware Tools in the guest operating system, and is not recommended.
- `Drivers` – Includes the SVGA, mouse, BusLogic, and `vmxnet` drivers.
  - `SVGA` – VMware SVGA driver. Excluding this feature limits the display capabilities of your virtual machine.
  - `Mouse` – VMware mouse driver. Excluding this feature decreases mouse performance in your virtual machine.
  - `Buslogic` – VMware BusLogic driver. If your virtual machine is configured to use the LSI Logic driver, you might want to remove this feature.
  - `VMXNet` – VMware `vmxnet` networking driver.
- `MemCtl` – VMware memory control driver. Recommended if you plan to use this virtual machine with VMware ESX Server. Excluding this feature hinders the memory management capabilities of the virtual machine running on an VMware ESX Server system.
- `Hgfs` – VMware shared folders driver. Recommended if you plan to use this virtual machine with VMware Workstation. Excluding this feature prevents you from sharing a folder between your virtual machine and the Workstation host.

To include a feature, use it with the `ADDLOCAL` option.

To exclude a feature, use it with the REMOVE option.

For example, to install everything but the shared folders driver, type the following on the command line:

```
msiexec –i "D:\VMware Tools.msi" ADDLOCAL=ALL REMOVE=Hgfs /qn
```

The SVGA, Mouse, BusLogic, vmxnet, and MemCtl features are children of the Drivers feature. Thus, on the command line, if you type:

```
msiexec –i "D:\VMware Tools.msi" ADDLOCAL=ALL REMOVE=Drivers /qn
```

you also skip installation of the SVGA, Mouse, BusLogic, vmxnet, and MemCtl drivers.

Installing VMware Tools on a Linux Guest

On a Linux guest, you can install VMware Tools within X or from the command line:

- "Installing VMware Tools Within X" on page 123
- "Installing VMware Tools from the Command Line with the Tar or RPM Installer" on page 125

Installing VMware Tools Within X

As an alternative to the following procedure, you can install VMware Tools within X using the .tar installer in a terminal window, as described in "Installing VMware Tools from the Command Line with the Tar or RPM Installer" on page 125.

To install VMware Tools from X with the RPM installer

1 Power on the virtual machine, and after the guest system has started, choose **VM>Install VMware Tools**.

The guest operating system mounts the VMware Tools installation virtual CD. A window manager might appear, displaying two files, one for the RPM installer and one for the tar installer. Alternatively, a VMware Tools CD icon might appear on the desktop.

2 Do one of the following:

- If you see a **VMware Tools CD** icon on the desktop, double-click it, and after it opens, double-click the RPM installer in the root of the CD-ROM.
- If you see a file manager window, double-click the RPM installer file.

In some Linux distributions, the **VMware Tools CD** icon might fail to appear. In this case, continue installing VMware Tools as described in "Installing VMware Tools from the Command Line with the Tar or RPM Installer" on page 125.

3 When prompted, enter the root password and click **OK**.

The installer prepares the packages.

4 Click **Continue** when the installer presents a dialog box that shows **Completed System Preparation**.

A dialog box appears with a progress bar. When the installer is done, VMware Tools is installed. There is no confirmation or finish button.

5 In an X terminal, as root (`su –`), run the following file to configure VMware Tools:

```
vmware-config-tools.pl
```

Respond to the questions the installer displays on the screen. Press Enter to accept the default value.

6 When done, exit from the root account:

```
exit
```

7 In an X terminal, launch the VMware Tools control panel:

```
vmware-toolbox &
```

For information about using this control panel to configure VMware Tools, see "VMware Tools Configuration Options" on page 132.

NOTE You can run VMware Tools as root or as a normal user. To shrink virtual disks or to change any VMware Tools scripts, you must run VMware Tools as root (`su –`).

Installing VMware Tools from the Command Line with the Tar or RPM Installer

The first step is performed on the host, within Workstation menus, and the remaining steps are performed inside the virtual machine.

To install VMware Tools with the tar installer or RPM installer

1 Power on the virtual machine, and after the guest system has started, choose **VM>Install VMware Tools**.

The remaining steps take place inside the virtual machine.

2 As root (`su –`), mount the VMware Tools virtual CD-ROM image and change to a working directory (for example, `/tmp`), as follows.

NOTE Some Linux distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the `mount` and `umount` commands described in this procedure. You still must untar the VMware Tools installer to `/tmp`.

Some Linux distributions use different device names or organize the `/dev` directory differently. If your CD-ROM drive is not `/dev/cdrom` or if the mount point for a CD-ROM is not `/mnt/cdrom`, you must modify the following commands to reflect the conventions used by your distribution:

```
mount /dev/cdrom /mnt/cdrom
cd /tmp
```

NOTE If you have a previous installation, delete the previous `vmware-tools-distrib` directory before installing. The location of this directory depends on where you placed it when you did the previous installation. Often it is placed in:

```
/tmp/vmware-tools-distrib
```

---

3 Uncompress the installer and unmount the CD-ROM image.

Depending on whether you are using the tar installer or the RPM installer, do one of the following:

- For the tar installer, at the command prompt, enter:

```
tar zxpf /mnt/cdrom/VMwareTools-5.0.0-<xxxx>.tar.gz
umount /dev/cdrom
```

Where `<xxxx>` is the build/revision number of the Workstation release.

- For the RPM installer, at the command prompt, enter:

```
rpm -Uhv /mnt/cdrom/VMwareTools-5.0.0-<xxxx>.i386.rpm
umount /dev/cdrom
```

Where `<xxxx>` is the build/revision number of the Workstation release.

NOTE If you attempt to install an `rpm` installation over a `tar` installation—or the reverse—the installer detects the previous installation and must convert the installer database format before continuing.

---

4 Depending on whether you are using the tar installer or the RPM installer, do one of the following:

- For the tar installer, run the VMware Tools tar installer:

```
cd vmware-tools-distrib
./vmware-install.pl
```

Respond to the configuration questions on the screen. Press Enter to accept the default value.

- For the RPM installer, configure VMware Tools:

```
vmware-config-tools.pl
```

Respond to the questions the installer displays on the screen. Press Enter to accept the default value.

5 Log off the root account.

```
exit
```

6 Start X and your graphical environment.

7 In an X terminal, launch the VMware Tools control panel:

```
vmware-toolbox &
```

For information about using this control panel to configure VMware Tools, see "VMware Tools Configuration Options" on page 132.

NOTE You can run VMware Tools as root or as a normal user. To shrink virtual disks or to change any VMware Tools scripts, you must run VMware Tools as root (`su -`).

Installing VMware Tools in a Solaris Guest

The first step is performed on the host, within Workstation menus, and the remaining steps are performed inside the virtual machine.

To install VMware Tools in a Solaris guest

1 Power on the virtual machine, and after the guest system has started, choose **VM>Install VMware Tools**.

The remaining steps take place inside the virtual machine.

2 Log in as root (`su -`) and, if necessary, mount the VMware Tools virtual CD-ROM image, as follows.

Usually, the Solaris volume manager—`vold`—mounts the CD-ROM under `/cdrom/vmwaretools`. If the CD-ROM is not mounted, restart the volume manager using the following commands:

```
/etc/init.d/volmgt stop
/etc/init.d/volmgt start
```

3 After the CD-ROM is mounted, change to a working directory (for example, `/tmp`) and extract VMware Tools, as follows:

```
cd /tmp
gunzip -c /cdrom/vmwaretools/vmware-solaris-tools.tar.gz | tar xf -
```

4 Run the VMware Tools tar installer:

```
cd vmware-tools-distrib
./vmware-install.pl
```

Respond to the configuration questions on the screen. Press Enter to accept the default value.

5 Log off of the root account.

```
exit
```

6 Start X and your graphical environment.

7 In an X terminal, launch the VMware Tools control panel:

```
vmware-toolbox &
```

For information about using this control panel to configure VMware Tools, see "VMware Tools Configuration Options" on page 132.

NOTE You can run VMware Tools as root or as a normal user. To shrink virtual disks or change VMware Tools scripts, you must run VMware Tools as root (`su -`).

Installing VMware Tools in a FreeBSD Guest

The first step is performed on the host, within Workstation menus, and the remaining steps are performed inside the virtual machine.

To install VMware Tools in a FreeBSD virtual machine

1 Power on the virtual machine, and after the guest system has started, choose **VM>Install VMware Tools**.

The remaining steps take place inside the virtual machine.

2 Be sure the guest operating system is running in text mode.

You cannot install VMware Tools while X is running.

3 As root (`su -`), mount the VMware Tools virtual CD-ROM image, change to a working directory (for example, `/tmp`), uncompress the installer, and unmount the CD-ROM image.

Some FreeBSD distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the `mount` and `umount` commands below. You still must untar the VMware Tools installer to `/tmp`.

```
mount /cdrom
cd /tmp
```

4 Untar the VMware Tools tar file:

```
tar zxpf /cdrom/vmware-freebsd-tools.tar.gz
umount /cdrom
```

5 Run the VMware Tools installer:

```
cd vmware-tools-distrib
./vmware-install.pl
```

6 Log out of the root account.

```
exit
```

7 Start X and your graphical environment

8 In an X terminal, launch the VMware Tools control panel:

```
vmware-toolbox &
```

For information about using this control panel to configure VMware Tools, see "VMware Tools Configuration Options" on page 132.

NOTE You can run VMware Tools as root or as a normal user. To shrink virtual disks or change VMware Tools scripts, you must run VMware Tools as root (`su -`).

In a FreeBSD 4.5 guest operating system, sometimes VMware Tools does not start after you install VMware Tools. In this case, reboot the guest operating system or start VMware Tools on the command line in the guest. An error message appears:

```
Shared object 'libc.so.3' not found.
```

The required library was not installed. This does not happen with full installations of FreeBSD 4.5, but does occur for minimal installations. To fix the problem of the missing library:

1 Insert and mount the FreeBSD 4.5 installation CD or access the ISO image file.

2 Change directories and run the installation script.

```
cd /cdrom/compat3x
./install.sh
```

Installing VMware Tools in a NetWare Virtual Machine

The first step is performed on the host, within Workstation menus, and the remaining steps are performed inside the virtual machine.

To install VMware Tools in a NetWare virtual machine

1 Power on the virtual machine, and after the guest system has started, choose **VM>Install VMware Tools**.

The remaining steps take place inside the virtual machine.

2 Load the CD-ROM driver so the CD-ROM device mounts the ISO image as a volume.

Do one of the following:

- In the system console for a NetWare 6.5 virtual machine, enter:

  ```
  LOAD CDDVD
  ```

- In the system console for a NetWare 6.0 or NetWare 5.1 virtual machine, enter:

  ```
  LOAD CD9660.NSS
  ```

- In the system console for a NetWare 4.2 virtual machine, enter:

  ```
  load cdrom
  ```

  Then mount the VMware Tools CD-ROM image by entering:

  ```
  cd mount vmwtools
  ```

When the driver finishes loading, you can begin installing VMware Tools, as described in the next step.

3 In the system console, enter one of the following:

- For NetWare 5.1, 6.0, or 6.5:

  ```
  vmwtools:\setup.ncf
  ```

- For NetWare 4.2:

  ```
  vmwtools:\setup
  ```

When the installation finishes, the message `VMware Tools for NetWare are now running` appears in the Logger Screen (NetWare 6.5 and NetWare 6.0 guests) or the Console Screen (NetWare 4.2 and 5.1 guests).

4 For NetWare 4.2 only, bring the guest operating system down.

In the system console, enter:

```
down
```

5 To restart the guest operating system, in the system console, enter:

```
restart server
```

After you install VMware Tools, make sure the VMware Tools virtual CD-ROM image (`netware.iso`) is not attached to the virtual machine. If it is, disconnect it. Right-click the CD-ROM icon in the status bar of the console window and choose **Disconnect**.

Starting VMware Tools If You Do Not Use a Session Manager

One of the executables used by VMware Tools in UNIX guests is `vmware-user`. This program implements the fit-guest-to-window feature, among other features.

Normally, on Linux, the VMware Tools service (`vmware-guestd`) starts and stops `vmware-user`. On Solaris, `vmware-user` is started automatically once you configure VMware Tools and then log out of the desktop environment and log back in.

However, if you run an X session without a session manager (for example, by using `startx` and getting a desktop and not using `xdm`, `kdm`, or `gdm`), then `vmware-guestd` won't start and stop `vmware-user`, and you must do it manually.

To start vmware-user manually

Use either of the following strategies:

- Add an X application name to the `/etc/vmware-tools/xautostart.conf` file.

  The `vmware-guestd` program looks in the `xautostart.conf` file, and if any application listed there is running, `vmware-guestd` tries to run `vmware-user`. If none of the applications listed in the file is running in X, find an application on your system that runs only when you are logged in to your X session and add it to the list.

- Add `vmware-user` to the appropriate X startup script.

  The `vmware-user` program is located in the directory where you selected to install binary programs, which defaults to `/usr/bin`. Which startup script you need to modify depends on your particular system.

  If you find that some features, such as copy and paste or drag and drop do not work, use the other strategy of adding an X application name to the `/etc/vmware-tools/xautostart.conf` file.

Uninstalling VMware Tools or Changing Which Modules Are Installed

This section includes procedures for removing VMware Tools from a UNIX guest operating system and a Windows guest.

To uninstall VMware Tools

- On a Windows guest, use the guest operating system's **Add/Remove Programs** item to remove VMware Tools.
- On a UNIX guest, log on as root (`su –`) and enter the appropriate command:
  - From a tar install, use the following command:

    ```
    vmware-uninstall-tools.pl
    ```

  - From an RPM install, use the following command:

    ```
    rpm -e VMwareTools
    ```

To repair or modify VMware Tools on a Windows guest

1 In Workstation, select the virtual machine and choose **VM>Install VMware Tools**.

2 Click **Change** to repair or modify which components of VMware Tools are installed.

You might need to use this button if, after a VMware Tools upgrade, certain features such as enhanced file sharing do not seem to be working. In this case, use the **Modify** option to make sure that the components you want are installed.

3 Complete the rest of the pages of the wizard.

VMware Tools Configuration Options

This section discusses VMware Tools configuration options in the following topics:

- "Using the VMware Tools Control Panel to Configure Tools" on page 133
- "Using the System Console to Configure VMware Tools in a NetWare Guest Operating System" on page 137

Using the VMware Tools Control Panel to Configure Tools

This section shows the options available in a Windows XP guest operating system. Similar configuration options are available in VMware Tools for other guest operating systems.

To open the VMware Tools control panel

- On Windows guests, click **VMware Tools** icon in the guest operating system's notification area.

  On Windows Vista guests, you need to be logged in as an Administrator user to open the VMware Tools control panel.

  If the **VMware Tools** icon does not appear in the notification area of the taskbar, go to **Start>Control Panel**. Locate the **VMware Tools** icon and double-click it to display the VMware Tools Properties dialog box.

  On the **Options** tab of the VMware Tools control panel, select **Show VMware Tools in the taskbar** and click **Apply**.

- On Linux, FreeBSD, and Solaris guests, open a terminal window and enter the command:

  ```
  /usr/bin/vmware-toolbox &
  ```

- On NetWare, do one of the following:

  - In a NetWare 5.1 or higher guest, choose **Novell>Settings>VMware Tools for NetWare**.
  - In a NetWare 4.2 guest, use VMware Tools commands in the system console. The VMware Tools program is called `vmwtool`. Its options are described in "Using the System Console to Configure VMware Tools in a NetWare Guest Operating System" on page 137.

Tabs in the VMware Tools control panel are described in the following sections:

- "Options Tab" on page 134
- "Devices Tab" on page 135
- "Scripts Tab" on page 135
- "Shared Folders Tab (Windows Guests Only)" on page 137
- "Shrink Tab" on page 137
- "About Tab" on page 137

Options Tab

In the **Options** tab, you can set the following options:

- **Time synchronization between the virtual machine and the host operating system** – You can synchronize the time in the guest operating system with the time on the host operating system only when you set the clock in the guest operating system to a time earlier than the time set on the host. For information about sychronizing time when the guest is set to a later time than the host, see "Using the VMware Tools Command-Line Interface" on page 144.

  Under some circumstances, the virtual machine might synchronize time with the host even though this item is not selected. If you want to disable time synchronization completely, power off the virtual machine, open the virtual machine's configuration file (`.vmx`) in a text editor, and set the following options to FALSE.

  Table 6-1. Time Synchronization Options

Option name	Relates to time sychronization when
`tools.syncTime`	Powering on a virtual machine.
`time.synchronize.restore`	Reverting to a snapshot.
`time.synchronize.resume.disk`	Resuming a suspended virtual machine.
`time.synchronize.continue`	Taking a snapshot.
`time.synchronize.shrink`	Shrinking a virtual disk.

  You can also use the VMware Tools command-line interface to set these and other time synchronization options. If you use this command-line interface, you do not need to power off the virtual machine. For more information, see "Using the VMware Tools Command-Line Interface" on page 144.

- **Show VMware Tools in the taskbar** – (Windows guests only) Select this option to display the **VMware Tools** icon in the taskbar.
- **Notify if upgrade is available** – (Windows guests only) Select this option if you want the **VMware Tools** icon to include a yellow caution icon when an upgrade is available.
- **Upgrade** button – (Windows guests only) This button becomes enabled when an upgrade is available. Clicking this button has the same effect as choosing **VM>Install VMware Tools** from the Workstation menu bar.

Devices Tab

In the **Devices** tab, you can enable or disable the following removable devices by selecting or deselecting the corresponding check boxes. Removable devices include floppy drives, CD-ROM drives, and USB devices, among others. You can also enable or disable removable devices in by choosing **VM>Removable Devices** from the Workstation menu bar.

Scripts Tab

If VMware Tools is installed in the guest operating system, and if you configure a virtual machine's power controls to use the "guest" options, one or more default scripts run on the guest whenever you change the power state of the virtual machine.

For example, if you use the virtual machine settings editor (choose **VM>Settings>Options>Power**) and set the **Power Off** control to use **Shutdown Guest**, then the `poweroff-vm-default` script runs when you click the **Power Off** button in the Workstation toolbar. This script causes the guest operating system to shut down gracefully. A description of each script is provided later in this section, in Table 6-2.

In Windows guests, the default scripts are located in the `Program Files\VMware\VMware Tools` folder. On UNIX, the default scripts are located in the `/etc/vmware-tools` directory.

You can use the **Scripts** tab to disable these scripts or to point to custom scripts for the **Suspend**, **Resume**, **Power On**, **Power Off**, and **Reset** buttons:

- To disable a script, select a script event, and clear the **Use Script** check box. Default scripts for suspending and resuming are written to work together. If you disable the script of one of these actions, disable the script for the other action as well.
- To use a script that you create, select a script event, select the **Use Script** check box, select **Custom script**, and use the **Browse** button to point to the script you want to use.

  You can also use the **Edit** button to edit a custom script. For information about creating the script, see "Using Custom Scripts When the Power State Changes" on page 139.

NOTE On UNIX guests, to edit scripts from the **Scripts** tab, `xterm` and `vi` must be installed in the guest operating system and must be in your PATH. You must be a root user to edit the script. You can also edit scripts manually using any text editor.

- To run a script immediately, select the script event you want and click **Run Now**.

  You might notice that you can successfully run a script by clicking the **Run Now** button in the VMware Tools control panel but that this same script fails when run as part of a Workstation power operation. This is because scripts run by clicking **Run Now** are run as the logged in user and have a different working directory than when scripts are run by `vmware-guestd`.

Table 6-2. VMware Tools Scripts

Script Name	Description
`poweroff-vm-default`	If you configured the power-off operation to shut down the guest, this script runs when the virtual machine is being powered off. If you configured the reset operation to restart the guest, this script runs when the virtual machine is being reset. This script has no effect on networking for the virtual machine.
`poweron-vm-default`	If you configured the power-on operation to start up the guest, this script runs when the virtual machine is being powered on rather than resumed. If you configured the reset operation to restart the guest, this script runs after virtual machine restarts. This script has no effect on networking for the virtual machine.
`resume-vm-default`	If you configured the power-on operation to start up the guest, or the reset operation to restart the guest, this script runs when the virtual machine is resumed after it was suspended. On Windows guests, if the virtual machine is configured to use DHCP, this script renews the IP address of the virtual machine. On Linux, FreeBSD, and Solaris guests, this script starts networking for the virtual machine.
`suspend-vm-default`	If you configured the suspend operation to suspend the guest, this script runs when the virtual machine is being suspended. On Windows guests, if the virtual machine is configured to use DHCP, this script releases the IP address of the virtual machine. On Linux, FreeBSD, and Solaris guests, this script stops networking for the virtual machine.

NOTE Scripts in Windows NT and Windows Me guest operating systems do not release and renew the IP address. Scripts cannot be run in Windows 95, NetWare, and FreeBSD guest operating systems.

Shared Folders Tab (Windows Guests Only)

On Windows guests, a **Shared Folders** tab provides information on how to access your shared folders on the host, so you can share files between the host and guest. For more information, see "Viewing Shared Folders in a Windows Guest" on page 175.

Although the **Shared Folders** tab does not appear in Linux or Solaris guests, you can share folders with Linux and Solaris guests. See "Viewing Shared Folders in a Linux or Solaris 10 Guest" on page 175.

Shrink Tab

In the **Shrink** tab, you can reclaim unused space in a virtual disk. However, some configurations do not allow you to shrink a virtual disk. For more information, see "Shrinking Virtual Disks" on page 200.

On UNIX guests, to shrink virtual disks, run VMware Tools as the root user (`su -`). If you shrink the virtual disk as a non-root user, you cannot prepare to shrink the parts of the virtual disk that require root-level permissions.

About Tab

The **About** tab displays version (build number) and copyright information. In Windows guests, this tab also shows the status of the VMware Tools Service.

Using the System Console to Configure VMware Tools in a NetWare Guest Operating System

In a NetWare virtual machine, using the system console, you can configure certain virtual machine options such as time synchronization, CPU idling, and device configuration with VMware Tools. The VMware Tools command-line program is called `vmwtool`. To see the options associated with this command, at the system console, enter:

```
vmwtool help
```

To enter `vmwtool` commands in the system console, use the following format:

```
vmwtool <command>
```

where `<command>` is one of the commands listed in Table 6-3.

Table 6-3. VMware Tools Commands for Netware Guests

vmwtool Command	Definition
`help`	Displays a summary of VMware Tools commands and options in a NetWare guest.
`partitonlist`	Displays a list of all disk partitions in the virtual disk and whether or not a partition can be shrunk.
`shrink [<partition>]`	Shrinks the listed partitions. If no partitions are specified, all partitions in the virtual disk are shrunk. The status of the shrink process appears at the bottom of the system console.
`devicelist`	Lists each removable device in the virtual machine, its device ID, and whether the device is enabled or disabled. Removable devices include the virtual network adapter, CD-ROM, and floppy drives.
`disabledevice [<device name>]`	Disables the specified device or devices in the virtual machine. If no device is specified, all removable devices in the virtual machine are disabled.
`enabledevice [<device name>]`	Enables the specified device or devices in the virtual machine. If no device is specified, all removable devices in the virtual machine are enabled.
`synctime [on|off]`	Lets you turn on or off synchronization of time in the guest operating system with time on the host operating system. By default, time synchronization is turned off. Use this command without any options to view the current time synchronization status.
`idle [on|off]`	Lets you turn the CPU idler on or off. By default, the idler is turned on. The CPU idler program is included in VMware Tools for NetWare guests. The idler program is needed because NetWare servers do not idle the CPU when the operating system is idle. As a result, a virtual machine takes CPU time from the host regardless of whether the NetWare server software is idle or busy.

Customizations to VMware Tools

This section contains the following topics:

- "Using Custom Scripts When the Power State Changes" on page 139
- "Executing Commands After You Power Off or Reset a Virtual Machine" on page 141
- "Passing a String from the Host to the Guest" on page 141
- "Passing Information Between the Guest and Another Program" on page 144

Using Custom Scripts When the Power State Changes

When VMware Tools is installed, if you configure a virtual machine's power controls to use the "guest," or "soft" power options, one or more default scripts run on the guest whenever you change the power state of the virtual machine. You change the power state either by using menu commands or by clicking the **Suspend**, **Resume**, **Power On**, and **Power Off** buttons.

What the default scripts do depends in part on the guest operating system:

- On Microsoft Windows guests, the default script executed when you suspend a virtual machine releases the IP address of the virtual machine. The default script executed when you resume a virtual machine renews the IP address of the virtual machine (this affects only virtual machines configured to use DHCP).

  In Windows guests, the default scripts are located in the `Program Files\VMware\VMware Tools` folder.

- On UNIX guests, the default script executed when you suspend a virtual machine stops networking for the virtual machine, while the default script executed when you resume a virtual machine starts networking for the virtual machine.

  On UNIX, the default scripts are located in the `/etc/vmware-tools` directory.

You can, however, create your own scripts and use them instead of the default scripts.

Scripts are run by the VMware Tools daemon (`VMwareService.exe` on Windows, and `vmware-guestd` on UNIX and Windows Vista).

Because `vmware-guestd` is run as root on UNIX and as System on Windows Vista, the scripts are run in a separate session from the logged-in user's session. The `vmware-guestd` program therefore has no knowledge of desktop sessions, which means that it cannot display graphical applications.

NOTE You might notice that you can successfully run a script by clicking the **Run Now** button in the VMware Tools control panel but that this same script fails when run as part of a Workstation power operation. This is because scripts run by clicking **Run Now** are run as the logged in user and have a different working directory than when scripts are run by `vmware-guestd`.

To use custom scripts

1 Study the default scripts to determine if you want to create your custom script by making changes to the default script and saving it to a new location.

In Windows guests, the default scripts are located in the `Program Files\VMware\VMware Tools` folder.

On UNIX, the default scripts are located in the `/etc/vmware-tools` directory.

2 Either modify the default script and save it with a different name, or write a completely different script.

If you write a new script, for Windows, create the script as a batch file. For UNIX, create the script in any executable format (such as shell or Perl scripts).

3 Associate each custom script with its particular power operation.

For more information, see "Scripts Tab" on page 135.

4 Make sure that the following conditions are met in the guest operating system:

- The virtual machine is using the latest version of VMware Tools.
- The VMware Tools service is running in the virtual machine.
- Depending on the operation the script performs, the virtual machine must have a virtual network adapter connected, or the power operation fails.

WARNING When you reinstall VMware Tools after you upgrade the Workstation software, any changes you made to the default scripts are overwritten. Any custom scripts you created remain untouched, but do not benefit from any underlying changes that enhance the default scripts.

Executing Commands After You Power Off or Reset a Virtual Machine

In a Linux, Solaris, or FreeBSD guest, you can have the VMware Tools service execute specific commands when you shut down or restart the guest operating system. This is in addition to any script that you might have specified to run when you shut down the guest operating system.

To execute these commands, you need to modify `/etc/vmware-tools/tools.conf`.

The commands are:

```
halt-command = <command>
```

where `<command>` is the command to execute when you shut down the guest operating system.

```
reboot-command = <command>
```

where `<command>` is the command to execute when you restart the guest operating system.

Passing a String from the Host to the Guest

This section describes how to pass a string from your virtual machine's configuration file in the host operating system to the guest operating system when you power on a virtual machine.

Use this feature only if you have a good understanding of a scripting language (for example, Perl or NetShell) and know how to modify system startup scripts.

How to Pass a String

There are two ways of passing strings to a virtual machine's guest operating system:

- Place a string in the virtual machine's configuration file by setting the string to the `machine.id` parameter. For example, you can set this string:

  ```
  machine.id = "Hello World."
  ```

- Pass the string to the guest operating system from the command line when you power on the virtual machine. For an example, see the procedure included at the end of this section.

What Can Be Used in Strings

You can pass items like the Windows system ID (SID), a machine name, or an IP address. Inside the guest operating system startup script, you can then have the service retrieve this string. The string can then be used in another script to set your virtual machine's system ID, machine name, or IP address.

When to Pass a String

Use this strategy, for example, to make copies of the same configuration file, add a different string to each (either in the configuration file itself or at the command line), and use these variations of the same configuration file to launch the same virtual disk in nonpersistent mode multiple times in a training or testing environment.

Following is an example of what portions of two configuration files that point to the same virtual disk might look like. Each configuration file contains its own unique string set for the `machine.id` parameter.

`<config_file_1>.vmx` contains:

```
ide0:0.present = TRUE
ide0:0.fileName = "my_common_virtual_hard_drive.vmdk"
machine.id = "the_string_for_my_first_vm"
```

`<config_file_2>.vmx` contains:

```
ide0:0.present = TRUE
ide0:0.fileName = "my_common_virtual_hard_drive.vmdk"
machine.id = "the_string_for_my_second_vm"
```

Passing a string is also useful when you want to deploy virtual machines on a network using a common configuration file, while providing each machine with its own unique identity. In this case, you specify the string at the command line. Launch each virtual machine with the `vmware -s` command. For an example, see the procedure "To retrieve a string and use it in a startup script" on page 143.

Each virtual machine disk file must be copied into its own directory if it shares its file name with another virtual machine disk file.

The following example uses a Windows host and guest to illustrate how you can use the service to retrieve a string containing what will become the virtual machine's machine name and IP address. In this example, W2K-VM is the machine name and 148.30.16.24 is the IP address.

To retrieve a string and use it in a startup script

1 Define the string by using one of the following methods:

- Add the following line to your virtual machine's configuration file:

  ```
  machine.id = "W2K–VM 148.30.16.24"
  ```

  Open virtual machine using this configuration file.

- Open the virtual machine from the command line by entering the following on one line:

  ```
  "C:\Program Files\VMware\VMware Workstation\vmware –s
                'machine.id=W2K–VM 148.30.16.24' C:\Virtual
                Machines\win2000\win2000.vmx"
  ```

  On a Linux host, the machine ID passed on the command line takes precedence and is passed to the guest operating system if the following conditions are met:

  - A virtual machine ID is specified in a configuration file.
  - You use that file to open the virtual machine.
  - You also specify a machine ID on the command line.

2 Retrieve the string in the virtual machine:

- In a Windows guest, the command to retrieve the string is:

  ```
  VMwareService ––cmd machine.id.get
  ```

- In a Linux guest operating system's startup script, add the following command before the network startup section. For example:

  ```
  /usr/sbin/vmware–guestd ––cmd 'machine.id.get'
  ```

  The location of `vmware–guestd` depends on the directory you specify at the time of installation.

3 Further customize this startup script so that it uses the string the service retrieved during startup to set the virtual machine's network name to W2K-VM and its IP address to 148.30.16.24.

Place this string in the script before the command to start the network services. If you're using a Windows 2000 guest operating system, for example, you can call the NetShell utility (`netsh`) and pass it the contents of the string, which then uses the string accordingly. That is, it can set a new IP address for the virtual machine, if that is what was passed in the string originally.

NOTE To prevent a string from being passed from the host to the guest through the service. Set the following line in your virtual machine's configuration file:

```
isolation.tools.getMachineID.disable = "TRUE"
```

Passing Information Between the Guest and Another Program

The VMware Tools service allows you to use VMware programmatic interfaces to manage virtual machines from your own independent programs and from existing frameworks developed by partners and third parties.

For more information about the VMware Infrastructure SDK, go to www.vmware.com/support/developer.

Using the VMware Tools Command-Line Interface

The VMware Tools command-line interface enables you to:

- Configure time synchronization in your Linux guest operating system without having to run X.
- Use some special time synchronization options without having to first power off the virtual machine and edit its configuration (`.vmx`) file.
- Configure VMware Tools options from the command line rather than from the VMware Toolbox graphical user interface.

A description of each option is provided in "Options for the VMware Tools --cmd Command" on page 145.

To use the VMware Tools command-line interface

1 On the guest operating system, change directories to the directory that contains the VMware Tools daemon:

   - On Microsoft Windows systems, the daemon is called `VMwareService.exe`.

     The location is `C:\Program Files\VMware\VMware Tools\VMwareService.exe`.

   - On UNIX systems, the daemon is called `vmware-guestd`.

     The location of `vmware-guestd` depends on the directory you specify at the time of installation. The default is `/usr/sbin/vmware-guestd`.

2 Use the `vmx.set_option` command to set the desired option.

The syntax is:

```
<daemon> --cmd "vmx.set_option <option> <old-val> <new-val>"
```

where:

`<daemon>` is `vmware-guestd` on UNIX systems or `VMwareService.exe` on Windows systems.

`<option>` is one of the options described in "Options for the VMware Tools --cmd Command" on page 145.

`<old-val>` and `<new-val>` are the old and new values, respectively. Use 0 to mean FALSE and 1 to mean TRUE.

Following is an example of setting time sychronization to TRUE on a Linux guest:

```
./vmware-guestd --cmd "vmx.set_option synctime 0 1"
```

When you use command-line options, the new settings are written into the virtual machine's configuration (`.vmx`) file.

NOTE For information about available commands other than the `--cmd` command, use the `--help` command-line command.

Options for the VMware Tools --cmd Command

Following are the options you can use as arguments to the `vmx.set_option` command-line command.

`synctime`

(Default is 0, which means FALSE) Controls whether the VMware Tools daemon periodically (every second) checks whether the guest operating system's time is lagging behind the host's. If so, the guest's clock is moved forward to match the host's clock. This option, by itself, can sync time in a forward fashion only. Use it in conjunction with `time.synchronize.tools.enable` to sync time backward.

Using the `synctime` command-line option is equivalent to using the time synchronization option on the **Options** tab of the VMware Toolbox, which sets a property called `tools.syncTime` in the virtual machine's configuration (`.vmx`) file.

`time.synchronize.tools.enable`

(Default is 0, which means FALSE) Controls whether toggling the `synctime` option to 1 causes an immediate, one-time synchronization to occur. Unlike the normal periodic time sync, which can move the guest clock only forward, this special time synchronization can move the guest clock either forward or backward. Disable this option if your guests must absolutely never sync backward in time.

`time.synchronize.tools.startup`

(Default is 0, which means FALSE) Controls whether the VMware Tools daemon will do a one-shot time synchronization when it starts up. This special time sync can be either forward or backward in time. Because the setting controls daemon's startup behavior, the daemon must be restarted for this option to have any effect. Make sure this option is set to 0 if your guests must absolutely never sync backward in time.

`time.sychronize.restore`

(Default is 1, which means TRUE) Controls whether time is synchronized between the host and guest when the guest reverts to a snapshot.

`time.sychronize.resume.disk`

(Default is 1, which means TRUE) Controls whether time is synchronized between the host and guest when you resume a suspended virtual machine.

`time.sychronize.continue`

(Default is 1, which means TRUE) Controls whether time is synchronized between the host and guest when you take a snapshot of a virtual machine.

`time.sychronize.shrink`

(Default is 1, which means TRUE) Controls whether time is synchronized between the host and guest when you shrink a virtual disk.

`autohide`

(Default is 1, which means TRUE) Makes the guest's cursor disappear when you move it off the edge of the guest's screen. To make the guest's cursor remain on the edge of the screen when you move it off the window, set this option to FALSE.

`enableDnD`

(Default is 1, which means TRUE) Enables drag and drop functionality so that you can drag and drop files and folders from a Windows or Linux host to a Windows, Linux, or Solaris guest. For more information about this feature, see "Using Drag and Drop" on page 169.

Running a Virtual Machine 7

This chapter includes the following topics:

- "Starting a Virtual Machine" on page 148
- "Running VMware Tools" on page 150
- "Shutting Down a Virtual Machine" on page 152
- "Deleting a Virtual Machine" on page 154
- "Controlling the Display" on page 154
- "Installing New Software" on page 166
- "Running Virtual Machines from Within an IDE" on page 167
- "Displaying the Virtual Machine as an Appliance" on page 168
- "Transferring Files and Text Between the Host and Guest" on page 169
- "Using Devices in a Virtual Machine" on page 179
- "Creating a Screen Shot of a Virtual Machine" on page 181
- "Creating a Movie of a Virtual Machine" on page 181
- "Using a VNC Client for Remote Connections to a Virtual Machine" on page 182

The illustrations in these sections show a Windows XP guest operating system. Some commands used in the illustrations are different from those used in other guest operating systems.

The following Workstation tasks are discussed in separate chapters:

- Using snapshots – See Chapter 10, "Preserving the State of a Virtual Machine," on page 223.
- Recording a virtual machine (experimental) – See Chapter 10, "Preserving the State of a Virtual Machine," on page 223.

- Cloning a virtual machine – See Chapter 11, "Cloning a Virtual Machine," on page 245.
- Working with virtual machine teams – See Chapter 12, "Configuring Teams," on page 253.

Starting a Virtual Machine

This section describes the ways you can launch a virtual machine:

- You can launch a virtual machine when Workstation is either running or not running, as described in:
  - "To start a virtual machine from the Workstation user interface" on page 148
  - "To open the console for a virtual machine that is running in the background" on page 149
- You can also start a virtual machine from the command line. See "To start a virtual machine from the command line" on page 149.

To start a virtual machine from the Workstation user interface

1 Start Workstation.

For instructions, see "Starting Workstation" on page 64.

2 Choose **File>Open** and browse to the configuration (`.vmx`) file for the virtual machine you want to use.

Refer to "Virtual Machine Location" on page 150 for help finding virtual machines on your host operating system.

If you add the name of the virtual machine to the **Favorites** list, you will not need to browse for the file when you want to open the virtual machine. See "The Favorites List" on page 73.

3 Click the **Power On** button to start the virtual machine.

4 Click anywhere inside the virtual machine console to give the virtual machine control of your mouse and keyboard.

5 If you need to log on to the operating system in the virtual machine, type your name and password just as you would on a physical computer.

NOTE On Windows hosts, if your Windows guest operating system prompts you to press Ctrl+Alt+Del before logging in, you might need to press Ctrl+Alt+Ins instead. You need to use Ctrl+Alt+Ins if the virtual machine is not using the enhanced virtual keyboard. See "Enhanced Virtual Keyboard for Windows Hosts" on page 341.

To start a virtual machine from the command line

1 Use the appropriate platform-specific instructions for starting the virtual machine:

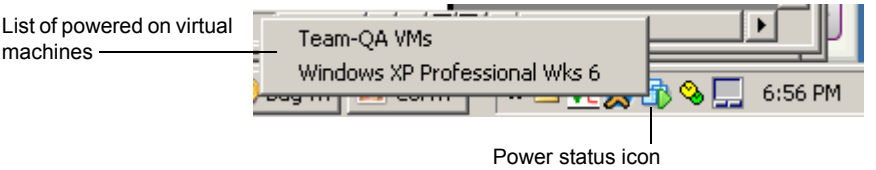
- "Startup Options for Workstation and Virtual Machines" on page 403
- "Using Startup Options in a Windows Shortcut" on page 405

2 To operate the virtual machine by using a command-line program, use the instructions in "Command-Line Application for Operating Virtual Machines" on page 405.

To open the console for a virtual machine that is running in the background

1 Click the power status icon in the notification area of the host's taskbar.

2 Click the tooltip that appears to display a list of the virtual machines.



This list contains the virtual machines and teams that belong to the logged in user.

NOTE If you do not see a "powered-on" icon in the system tray, make sure that you have set the preference to show it. From the Workstation menu bar, choose **Edit>Preferences>Workspace**, and select the check box for showing the tray icon.

3 Click the machine you want to open.

Workstation starts and displays the console view of the virtual machine.

Virtual Machine Location

By default, virtual machine files are stored in the virtual machine's working directory:

- **On Windows hosts** VMware Workstation stores virtual machines in the `My Documents` folder of the user who is logged on at the time the virtual machine is created.

  On Windows Server 2003, Windows XP and Windows 2000, the default folder is `C:\Documents and Settings\<username>\My Documents\My Virtual Machines\<guestOSname>`.

  On Windows Vista, the default folder is `C:\Users\<username>\Virtual Machines\<guestOSname>`.

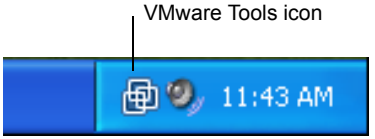
- **On Linux hosts** VMware Workstation stores virtual machines in `<homedir>/vmware/<guestOSname>`, where `<homedir>` is the home directory of the user who is logged on at the time the virtual machine is created.

The working directory is also where Workstation stores suspended state (`.vmss`), snapshot (`.vmsn`), and redo log files. You can find the path to the working directory by displaying the virtual machine settings editor (select the virtual machine and choose **VM>Settings>Options>General**). For more information about the working directory, click the **Help** button on the **Options>General** tab.

Running VMware Tools

For best performance, make sure VMware Tools is installed and running in your virtual machine.

After you install VMware Tools in a Windows virtual machine, the VMware Tools services will start when you start the guest operating system. The **VMware Tools** icon appears in the guest's notification area unless you disable the icon.



On Windows guests, if the **VMware Tools** icon includes a yellow caution icon, it means that an update is available. To perform the update, click the icon, and on the **Options** tab that appears, click the **Upgrade** button.

If the **VMware Tools** icon appears with a red circle and slash over it, this means that the VMware Tools service is not running. To start the service, choose **Run** from the

Windows **Start** menu, and enter **`services.msc`**. In the window that appears, start the service called **VMware Tools Service**.

If the **VMware Tools** icon does not appear in the notification area of the Windows guest's taskbar, use the VMware Tools control panel in the guest operating system to display it, as described in the following procedure.

To change property settings for VMware Tools on Windows systems

1 In the guest system, click **Start>Settings>Control Panel** or **Start>Control Panel**, depending on the version of Windows you are using.

On Windows Vista guests, you need to be logged in as an Administrator user to open the VMware Tools control panel.

2 In the Control Panel, locate the VMware Tools icon and double-click it.

3 In the VMware Tools Properties dialog box that appears, on the **Options** tab, select **Show VMware Tools in the taskbar**.

This setting reactivates the icon in the notification area of the taskbar.

4 To change any other VMware Tools properties, use the tabs in this dialog box.

For more information about the properties, click the **Help** button.

To change property settings for VMware Tools on a Linux, Solaris, or FreeBSD system

1 Boot the guest operating system, start X, and launch your graphical environment.

2 Launch the VMware Tools background application with this command:

```
vmware-toolbox &
```

You can run VMware Tools as root or as a normal user. To shrink virtual disks or to change any VMware Tools scripts, you must run VMware Tools as root (`su -`).

3 To change any other VMware Tools properties, use the tabs in this dialog box.

For more information about the properties, click the **Help** button.

Shutting Down a Virtual Machine

As with physical computers, you can shut down your guest operating system before you power off your virtual machine or team.

To shut down a Windows guest operating system

1 In the guest system, shut down the operating system as you would if you were using a physical machine rather than a virtual machine.

For example, in Windows XP, click **Start>Shut Down**. In the dialog box that appears, choose **Shut Down** and click **OK**.

2 After the guest operating system shuts down, click **Power Off** to turn off the virtual machine.

NOTE Alternatively, you can configure the **Power Off** button to shut down the guest operating system before powering off the virtual machine. See "Powering Off Versus Shutting Down and Resetting Versus Restarting" on page 152.

You are not required to shut down the guest before exiting Workstation. If you want to exit Workstation but leave the virtual machine running in the background rather than shutting it down, see "Closing Virtual Machines and Exiting Workstation" on page 84.

Powering Off Versus Shutting Down and Resetting Versus Restarting

You can configure the **Power Off** button to turn off a virtual machine or team in either of two ways:

- Set the **Power Off** button to work the same way a power switch works on a power supply. The virtual machine is abruptly powered off, with no consideration for work in progress.

WARNING If a virtual machine is writing to disk when it receives a **Power Off** command, data corruption might occur.

- Set the **Power Off** button to send a shut down signal to the guest operating system. An operating system that recognizes this signal shuts down gracefully.

  To use this **Shutdown Guest** option, make sure VMware Tools is installed in the guest operating system. The VMware Tools service then issues a shutdown command and runs a script to shut down cleanly.

Similarly, you can configure the **Reset** button to work the same way as a reset switch, so that it resets the virtual machine abruptly, with no consideration for work in progress. Or you can set the **Reset** button to have the VMware Tools service send a restart signal to the guest operating system. It then shuts down gracefully and restarts.

NOTE Not all guest operating systems respond to a shut down signal from the **Power Off** button, or to a restart signal from the **Reset**. If your operating system does not respond to the signal, shut down or restart from within the operating system, as you would with a physical machine.

To configure the Power options for a virtual machine

1 Start Workstation and select the virtual machine.

The virtual machine can be powered on or off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Power**.

4 In the Power Controls area of the dialog box, specify whether you want the **Power Off** button to shut down the guest gracefully or to abruptly power the virtual machine off.

The selection you make is reflected in the tooltip you see when you place your mouse pointer over the **Power Off** button.

5 Similarly, specify how you want the **Reset** button to work.

It can either act as a reset switch and abruptly reset the guest operating system, or it can send a restart signal to the guest operating system so that it shuts down gracefully and restarts.

To use the **Restart Guest** option, make sure VMware Tools is installed in the guest operating system.

6 If you want to change any of the other settings and need more information, click **Help** to display the online help.

For UNIX guests, if you want to pass X toolkit options when you power on a virtual machine, see Chapter A, "Workstation Command-Line Reference," on page 403.

Deleting a Virtual Machine

Workstation includes commands to remove a virtual machine from the **Favorites** list or completely delete the virtual machine. You do not need to manipulate files in the host file system to delete a virtual machine.

To remove a virtual machine from the Favorites list

In the **Favorites** list, right-click the name of the virtual machine and choose **Remove from Favorites**.

This choice does not affect the virtual machine itself. All virtual machine and team files remain intact on the host computer file system.

To delete a virtual machine from the system

In the **Favorites** list, right-click the name of the virtual machine and choose **Delete from Disk**.

Alternatively, select the virtual machine and, from the Workstation menu bar, choose **VM>Delete from Disk**.

To remove a virtual machine from a team

Open the team, as described in "Opening and Closing a Team" on page 256. In the summary view for the team, in the **Virtual Machines and LAN Segments** section, right-click the name of the virtual machine, and choose **Remove from Team**.

Alternatively, select the team in the **Favorites** list and, from the Workstation menu bar, choose **Team>Remove><name_of_virtual_machine>**.

Controlling the Display

You can control the VMware Workstation display to suit the way you prefer to work with your virtual machines. This section includes the following topics:

- "Simplifying the Screen Display" on page 155
- "Using Full Screen Mode" on page 156
- "Using Quick Switch Mode" on page 157
- "Reporting Battery Information in the Guest Operating System" on page 158
- "Using Exclusive Mode" on page 158
- "Using Multiple Monitors" on page 160
- "Fitting the Workstation Console to the Virtual Machine Display" on page 163
- "Working with Nonstandard Resolutions" on page 165

Simplifying the Screen Display

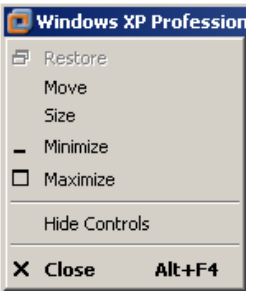
You can turn off the display of many of the controls visible in the VMware Workstation window.

Use the **View** menu to toggle the following controls on or off:

- Sidebar
- Toolbar
- Status bar
- Virtual machine tabs

On a Windows host, you can also hide the menu bar, the toolbar, the status bar, and the sidebar. Click the title bar icon, and choose **Hide Controls**.

Figure 7-1. Hide Controls Command on a Windows Host

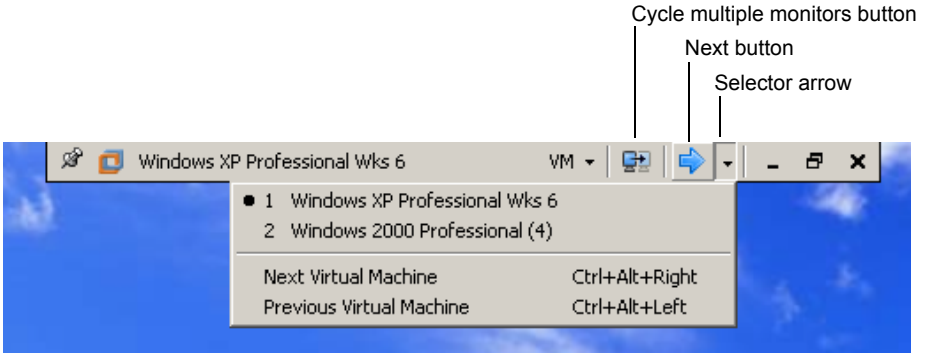


For the simplest VMware Workstation window on a Windows host, first choose **View>Tabs** to turn off the tabs. Then, from the title bar icon shortcut menu, choose **Hide Controls**. This window is very similar to full screen mode except that the task bars for both the host and the guest are displayed.

Using Full Screen Mode

In full screen mode, the virtual machine display fills the screen, so you no longer see the borders of the VMware Workstation window.

Figure 7-2. Full Screen Toolbar on a Windows Host



NOTE If you plan to run the virtual machine in full screen mode on a laptop computer, also see "Reporting Battery Information in the Guest Operating System" on page 158.

To use full screen mode

1 Start Workstation and make sure one or more virtual machines are powered on.

2 If you have multiple monitors, move the Workstation window into the monitor you want to use for displaying this virtual machine in full screen mode.

NOTE For best performance, make sure the guest operating system has VMware Tools installed. See "Installing and Upgrading VMware Tools" on page 113.

3 To enter full screen mode, select a powered-on virtual machine and do one of the following:

- From the menu bar, choose **View>Full Screen**.
- Click the **Full Screen** button on the toolbar.
- Press Ctrl+Alt+Enter.

4 To switch from full screen mode back to windowed mode, which shows your virtual machine inside a Workstation window again, do one of the following:

- Click the **Restore** button on the full screen toolbar.
- Press Ctrl+Alt+Enter.

5 To hide the full screen toolbar and menus while you are using full screen mode, click the push pin icon and move your mouse pointer off of the toolbar.

This action will "unpin the toolbar." The toolbar slides up to the top of the monitor and disappears.

6 To display the toolbar again, move the mouse pointer to the top of the screen until the toolbar appears.

If you want the toolbar to remain on the screen, click the push pin icon again.

7 To switch from one powered-on virtual machine to another while in full screen mode, do one of the following:

- Click the **Next** button on the toolbar, as shown in Figure 7-2.
- Click the virtual machine arrow, as shown in Figure 7-2.

  The virtual machine selector arrow enables you to choose a specific powered-on virtual machine.
- Press Ctrl+Alt+right arrow to go to the next virtual machine, or press Ctrl+Alt+left arrow to go to the previous virtual machine.

8 Use the **VM** menu on the toolbar to access any of the commands that you normally see in the Workstation **VM** menu.

NOTE To display the virtual machine across two or more monitors in full screen mode, see "Using Multiple Monitors" on page 160.

Using Quick Switch Mode

Quick switch mode is similar to full screen mode with the addition of tabs at the top of the screen for switching from one virtual machine to another. The other difference is that you can use quick switch mode with virtual machines that are powered on or off, whereas full screen mode is available only for virtual machines that are powered on.

In quick switch mode, the virtual machine's screen is resized to fill the screen completely, except for the space occupied by the tabs.

To enter quick switch mode, choose **View>Quick Switch**.

To view the Workstation menu and toolbar while you are using quick switch mode, move the mouse pointer to the top of the screen.

To resize a guest operating system's display so it fills as much of the screen as possible in quick switch mode, choose **View>Fit Guest Now**. The **Fit Guest Now** option works only if you have the current version of VMware Tools installed in the guest operating system.

To get out of quick switch mode, move the mouse pointer to the top of the screen to activate the menu and choose **View>Quick Switch**.

Reporting Battery Information in the Guest Operating System

To run a virtual machine on a laptop in full-screen mode, use the following procedure to ensure that battery information is reported in the guest. This way, you can determine when the battery is running low.

To report the status of the battery in the guest

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Options** tab, select **Power**.

4 Select the **Report battery information to guest** check box and click **OK**.

Using Exclusive Mode

You might want to use exclusive mode if you want to run graphics-intensive applications, such as games, in full screen mode. Like full screen mode, exclusive mode causes the Workstation virtual machine display to fill the screen.

Drawbacks to using exclusive mode include:

- The full screen toolbar is not available in exclusive mode. To configure any virtual machine settings, you need to leave exclusive mode (by pressing Ctrl+Alt).
- Exclusive mode does not use more than one monitor.
- Exclusive mode causes the host resolution to resize, which can cause items on the host desktop to be moved.

For best performance, make sure the guest operating system has VMware Tools installed. See "Installing and Upgrading VMware Tools" on page 113.

To use exclusive mode

1 Start Workstation and make sure one or more virtual machines are powered on.

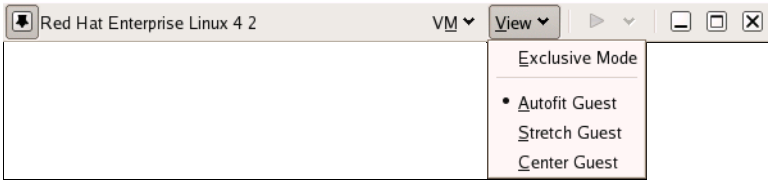
2 If you have multiple monitors, move the Workstation window into the monitor you want to use for displaying this virtual machine in exclusive mode.

3 Press Ctrl+Alt+Enter to enter full screen mode.

4 On the full screen toolbar, do one of the following:

- On Windows hosts, click the **Workstation** icon to display the system menu and choose **Exclusive Mode**.

- On Linux hosts, click the **View** menu on the full screen toolbar and choose **Exclusive Mode**.



5 To exit full screen mode and return to windowed mode, press Ctrl+Alt.

In exclusive mode, you cannot display the full screen toolbar.

Using Multiple Monitors

If your host has a multiple-monitor display, you can run a different virtual machine on each monitor. You can also have one virtual machine use two or more monitors.

Before you attempt to use multiple monitors for displaying one virtual machine, make sure the virtual machine meets these requirements:

- The virtual machine is a Workstation 6 or higher virtual machine.
- VMware Tools is installed *and running* in the virtual machine's guest operating system. The version of VMware Tools must be the version included in Workstation 6 or higher. For instructions, see "Installing and Upgrading VMware Tools" on page 113.
- The guest operating system in the virtual machine is Windows XP, Windows Vista, or Linux.
- On the host, the display settings for monitors must be set in a compatible topology. For example, the left-most monitor cannot not below any other monitor. It does not matter if the monitors have different resolutions or orientations. When entering full screen mode, the monitor containing the Workstation window cannot be below another monitor.

  Put another way: When you use the Windows display properties controls, if you select a monitor icon and begin to drag it to a new location, a pop-up displays the coordinates. If a coordinate shown for the new location of the icon is a negative number, that location will not work.

This section includes the following procedures:

- "To use multiple monitors to display one virtual machine" on page 160
- "To display multiple virtual machines in multiple monitors" on page 162

To use multiple monitors to display one virtual machine

1 Start Workstation and choose **Edit>Preferences**.

  The preferences editor opens.

2 In the Preferences dialog box, click the **Display** tab, and in the **Full Screen** section, select **Autofit guest** and click **OK**.

3 Select the Workstation 6 virtual machine.

  Make sure the virtual machine is powered off.

4 Choose **VM>Settings**.

  The virtual machine settings editor opens.

5 Click the **Hardware** tab, and select **Display**.

If **Display** does not appear in the list on the **Hardware** tab, it probably means that the virtual machine is a Workstation 4 or 5 virtual machine. Only Workstation 6 virtual machines have this feature.

6 On the **Display** tab, under most circumstances, select **Use host setting for monitors**.

This option means that if the virtual machine is run on a host that is using one monitor, the virtual machine will see only one monitor. But if the same virtual machine is moved to a different host that is using two monitors, the virtual machine will see two monitors.

Here, the number of monitors depends on the number of monitors the host recognizes when it starts up. For example, if you power on a laptop that is undocked, the host setting is one monitor, even if you later place the running laptop in a docking station that uses two monitors.

Similarly, if the host has one monitor and you suspend the virtual machine and then change your host to have two monitors, when you resume, the virtual machine will still be configured to use one monitor. You will need to restart the virtual machine to detect the new settings.

7 If you set a specific number of monitors, also specify a sufficient maximum resolution.

The resolution of a host monitor that you use to display the virtual machine must not exceed the **Maximum resolution** setting you specify here.

8 Power on the virtual machine and choose **View>Full Screen** from the Workstation menu bar.

For more information about full screen mode, see "Using Full Screen Mode" on page 156.

NOTE Make sure the virtual machine is completely powered on. If when you power on the virtual machine it is set to be restored from a snapshot and if background snapshots are enabled, powering on might take longer. In this case, displaying the virtual machine to two monitors might not work correctly at first. If you see this issue, go to **Edit>Preferences>Priority** deselect the check box called **Take and restore snapshots in the background**.

---

9 On the full screen toolbar, click the **Cycle Multiple Monitors** button.

The **Cycle Multiple Monitors** button is available only if the host has more than one monitor. This button is shown in Figure 7-2, "Full Screen Toolbar on a Windows Host," on page 156.

If the virtual machine does not display correctly, use the system menu (on Windows hosts) or the **View** menu (on Linux hosts) and make sure **Autofit Guest** is selected.

NOTE Clicking the **Cycle Multiple Monitors** button causes the guest operating system's desktop to extend to the additional monitor or monitors. On Windows guests, you do not need to, and should not, use the Windows display properties settings to configure multiple monitors.

---

10 If you have more than two monitors, and you want the virtual machine to stretch across a different two monitors, click the **Cycle Multiple Monitors** button again.

The ordering of the monitors depends on the order in which the monitors were added to the host operating system.

11 To return to using only one monitor, click the **Cycle Multiple Monitors** button until the display returns to one monitor.

To display multiple virtual machines in multiple monitors

1 If you have two or more monitors, do one of the following:

- Open multiple Workstation windows.

  You can either repeat the procedure you used to start Workstation the first time or you can choose **File>New>Window** from the Workstation menu bar.

  Although you have two Workstation windows, both windows operate in a single Workstation process, which saves memory and allows preferences and **Favorites** list items to be shared.

- (Linux only) Start multiple instances of Workstation.

  On Linux hosts, if you want to run separate Workstation processes in different X servers, start the second instance of Workstation with the `–W` flag. In a terminal window, enter:

  ```
  vmware –W &
  ```

2 Start one or more virtual machines in each VMware Workstation window.

3 Drag each Workstation window to the monitor on which you want to use it.

For the largest possible screen display, switch each of the windows to full screen mode (choose **View>Full Screen**). For more information, see "Using Full Screen Mode" on page 156.

4 To switch mouse and keyboard input from the virtual machine on the first screen to the virtual machine on the second screen, move the mouse pointer from one to the other.

You do not need to take any special steps if VMware Tools is running in both guest operating systems and if you are using the default settings for grabbing input.

If you changed the defaults, you might need to press Ctrl+Alt to release the mouse pointer from the first virtual machine, move it to the second virtual machine, and click in the second virtual machine so it will grab control of mouse and keyboard input.

Fitting the Workstation Console to the Virtual Machine Display

The **View** menu's **Autofit** and **Fit** commands allow you to match the Workstation console with the guest operating system display size.

With both **Autofit** commands toggled off, Workstation does not automatically match window sizes as you work. Scroll bars appear in the console when the Workstation console is smaller than the guest operating system display. A black border appears in the console when the console is larger than the guest operating system display.

The **Autofit** and **Fit** commands are described Table 7-1.

Table 7-1. Autofit and Fit Commands

View Menu Command	Description
Autofit Window[1]	Causes the Workstation console to maintain the size of the virtual machine's display resolution. If the guest operating system changes its resolution, the Workstation console resizes to match the new resolution.
Autofit Guest[1]	Causes the virtual machine to resize the guest display resolution to match the size of the Workstation console.

1. An **Autofit** command is toggled on or off each time you select it. If both **Autofit** commands are toggled on, you can manually resize the Workstation console, but the guest operating system can also resize the Workstation console.
2. This command is redundant when one of the **Autofit** options is active because the console and the guest operating system display are the same size.

Table 7-1. Autofit and Fit Commands (Continued)

View Menu Command	Description
Fit Window Now[2]	Causes the Workstation console to match the current display size of the guest operating system.
Fit Guest Now[2]	Causes the guest operating system display size to match the current Workstation console.

1. An **Autofit** command is toggled on or off each time you select it. If both **Autofit** commands are toggled on, you can manually resize the Workstation console, but the guest operating system can also resize the Workstation console.
2. This command is redundant when one of the **Autofit** options is active because the console and the guest operating system display are the same size.

Considerations for Display Resizing in Linux Guests

For Linux guests, the following considerations apply to display resizing:

- If you have virtual machines that were suspended under a version of VMware Tools before version 5.5, display resizing will not work until the virtual machines are completely powered off and powered on again. (Rebooting the virtual machine is not sufficient.)
- Update VMware Tools to the latest version in the guest for the display resizing options to work.
- Before you can use the **Autofit Guest** and **Fit Guest Now** options, VMware Tools must be running.
- All the restrictions on resizing that the X11 Windows system imposes on physical hosts apply to guests:
  - You cannot resize to a mode that is not defined. The VMware Tools configuration script will add a large number of mode lines, but you will not get 1-pixel granularity as in Windows. VMware Tools adds modelines in 100-pixel increments. This means you cannot resize a guest larger than the largest mode defined in your X11 configuration file. If you attempt to resize larger, a black border will appear and the guest will stop growing.
  - The X server always starts up in the largest resolution that is defined. This cannot be avoided. The XDM/KDM/GDM login screen will always appear at the largest size. But both Gnome and KDE allow you to specify your preferred resolution, so you can reduce the guest display size after you log in.

Considerations for Display Resizing in Solaris Guests

For Solaris 10 guests, the following considerations apply to display resizing:

- Update VMware Tools to version 6.0 or higher in the guest for the display resizing options to work.
- Before you can use the **Autofit Guest** and **Fit Guest Now** options, VMware Tools must be running.
- Solaris 10 guests must be running an Xorg X server and JDS/Gnome.

Working with Nonstandard Resolutions

A guest operating system—and its applications—might react unexpectedly when the Workstation console size is not a standard VESA resolution (640×480, 800×600, 1024×768, and so on).

For example, the **Autofit Guest** and **Fit Guest Now** commands allow your guest operating system screen resolution to be set smaller than 640×480, but some installers do not run at resolutions smaller than 640×480. Programs might refuse to run. Error messages might include such phrases as "VGA Required To Install" or "You must have VGA to install."

There are two ways to work around this problem with nonstandard resolutions:

- If your host computer's screen resolution is high enough, you can enlarge the window, and choose **Fit Guest Now**.
- If your host computer's screen resolution does not allow you to enlarge the Workstation console sufficiently, you can manually set the guest operating system's screen resolution to 640×480 or larger.

Installing New Software

Installing new software in a Workstation virtual machine is like installing it on a physical computer. The only additional steps you need to take are:

- Make sure that Workstation can access the media you want to use for installing the software. From the Workstation menu, choose **VM>Removable Devices** and verify that the virtual machine has access to the CD-ROM drive, ISO image file, or floppy drive, as needed.

  For more information, see "Adding DVD/CD-ROM and Floppy Drives to a Virtual Machine" on page 210.

- Set the final memory size for your virtual machine and install VMware Tools before you activate the software.

  Some applications use a product activation feature that creates a key based on the virtual hardware in the virtual machine where it is installed. Changes in the configuration of the virtual machine might require you to reactivate the software. To minimize the number of significant changes, set the memory size and install VMware Tools.

Disabling Acceleration If a Program Won't Run

In rare instances, you might find that when you install or run software inside a virtual machine, Workstation appears to hang. Generally, the problem occurs early in the program's execution. In many cases, you can get past the problem by temporarily disabling acceleration in the virtual machine.

To disable acceleration

1 Start Workstation and select the virtual machine.

  The virtual machine can be either powered off or powered on.

2 Choose **VM>Settings**.

  The virtual machine settings editor opens.

3 Click **Options**, and select **Advanced**.

4 In the **Settings** section, select **Disable acceleration** and click **OK**.

This setting slows down virtual machine performance, so it is recommended only for getting past the problem with running the program. After you pass the point where the program was encountering problems, try returning to the virtual machine settings editor and removing the check beside **Disable acceleration**.

Running Virtual Machines from Within an IDE

If you want to use virtual machines for testing code as part of your development process, you will be interested in the Workstation IDE (integrated development environment) plug-ins. Workstation plug-ins enable you to easily test, run, and debug programs in virtual machines.

The plug-ins allow you to perform these actions from within Visual Studio (Windows only) or Eclipse (Windows or Linux). When a plug-in is installed, additional user interface items are added to the IDE. For example, in Visual Studio, you will see a toolbar button called **Configure the Virtual Debugger for this project**.

Clicking this button in Visual Studio enables you to specify settings such as the location of the virtual machine, which setup or clean-up scripts to execute, the location of shared folders, and directories to be copied between the host and guest.

In Eclipse, the plug-in adds new launch configuration types, which let you configure many of these same things.

Depending on the configuration setting you specify, when the application finishes running, the virtual machine is powered off, suspended, reverted to a snapshot, or left in its current state.

To install the Eclipse Integrated Virtual Debugger or the Visual Studio Integrated Virtual Debugger, you have the following options:

- If you have already installed Visual Studio or Eclipse, you can install either or both of these IDE plug-ins when you install Workstation, as follows:
  - On Windows hosts, when you complete the Workstation Installation wizard, if you have Visual Studio or Eclipse already installed, the virtual debuggers are installed by default. If you do not want to install them, you need to choose the Custom setup and deselect them.
  - On Linux hosts, during installation, you are prompted to specify whether you want the debugger installed.
- If you already have Workstation installed, run the Workstation installer again:
  - On Windows hosts, choose **Modify** to install the virtual debuggers.
  - On Linux hosts, when prompted, specify that you do want the debugger installed.

For information about installing and using the Workstation IDE plug-ins, see Appendix B, “Using the Eclipse Integrated Virtual Debugger,” on page 411 and Appendix C, “Using the Visual Studio Integrated Virtual Debugger,” on page 423.

Displaying the Virtual Machine as an Appliance

If you want a virtual machine to function as an appliance, such as a Web server with a browser-based interface, set the virtual machine to display its appliance view when starting up, rather than the operating system console.

The appliance view displays a brief description of the type of server or appliance and provides a link that opens the browser on the host system and connects to the appliance's management console. The following procedure describes the settings you need in order to create this presentation.

NOTE The appliance view cannot be displayed for virtual machines that are part of a team, just as the summary view is not displayed for individual members of a team.

To set up appliance view for a virtual machine

1 Verify that the virtual machine is a Workstation 6 virtual machine.

For instructions on upgrading, see "Changing the Version of the Virtual Machine" on page 59.

2 Select the virtual machine.

The virtual machine can be either powered on or off.

3 Choose **VM>Settings**.

The virtual machine settings editor opens.

4 Click the **Options** tab, and select **Appliance View**.

5 Make sure the **Enable appliance view** check box is selected.

6 Complete the fields on this panel to create the text and images that users will see when the virtual machine starts up:

- Only the **Name** field is required.
- Specify the TCP/IP port number that the appliance will use to serve HTTP content.
- If you include an image file, it must be a PNG or BMP file. The maximum size is 256 x 256 pixels.
- If you do not select **Switch to appliance view at power on**, the console view will be displayed. Often this view shows only a simple display of the virtual machine's IP address and tells the user to open a browser.

7 Click **OK** to close the virtual machine settings editor.

When a user starts up this virtual machine, the newly created appliance view is displayed. It first displays a "powering on" message and then provides a link to click in order to access the appliance's management console.

Transferring Files and Text Between the Host and Guest

Workstation gives you several mechanisms for transferring files between the host and guest. You can transfer files:

- "Using Drag and Drop" on page 169
- "Using Copy and Paste" on page 170
- "Using Shared Folders" on page 171
- "Using a Mapped Drive (Windows Only)" on page 178

Using Drag and Drop

To use the drag-and-drop feature, make sure you have VMware Tools installed on the virtual machine. With this feature, you can move files and directories easily between Linux and Windows hosts and Linux, Windows, and Solaris 10 guests, but not between Windows 95 and Windows 98 guests.

Linux hosts and guests must be running X Windows. Solaris 10 guests must be running an Xorg X server and JDS/Gnome.

You can drag and drop files or folders from a file manager, such as Windows Explorer, on the host to a file manager in the virtual machine and vice versa. You can also drag files from a file manager to an application that supports drag and drop, or from applications such as zip file managers that support drag-and-drop extraction of individual files. You can also drag and drop files from one virtual machine to another.

When you drag a file or folder from host to virtual machine or from virtual machine to host, Workstation copies the file or folder to the location where you drop it. This means, for example, that if you drop a file on the desktop icon of a word processor, the word processor opens with a copy of the original file. The original file does not reflect any changes you make to the copy.

Initially, the application opens using a copy of the file that is stored in your temp directory. On Windows, this is the file specified in the `%TEMP%` environment variable, and on Linux and Solaris, it is the `/tmp/VMwareDnD` directory. To protect any changes you make, choose **File>Save As** from the application's menu and save the file in a different directory. Otherwise, it can be overwritten or deleted by mistake.

To prevent files from accidentally being transferred between the virtual machine and the host, turn off this feature, as described in the following procedure.

To enable or disable drag and drop for a virtual machine

1 Make sure VMware Tools is installed on the virtual machine.

2 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

3 Choose **VM>Settings**.

The virtual machine settings editor opens.

4 Click the **Options** tab, and select **Guest Isolation**.

5 To enable or disable the setting, use the check box called **Enable drag and drop to and from this virtual machine** and click **OK**.

Using Copy and Paste

To use the copy and paste feature, make sure you have VMware Tools installed on the virtual machine. Copying and pasting text and files works with Linux and Windows hosts and Linux, Windows, and Solaris 10 guests. You can also copy and paste text and files from one virtual machine to another.

Linux hosts and guests must be running X Windows. Solaris 10 guests must be running an Xorg X server and JDS/Gnome. Copying and pasting files does not work on Windows 95, 98, and NT guests.

You can cut (or copy) and paste text between applications in the virtual machine and the host computer or between two virtual machines. Use the normal hot keys or menu choices to cut, copy, and paste.

To prevent accidental copying and pasting from one environment to another, turn off this feature, as described in the following procedure.

To enable or disable copying and pasting

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Guest Isolation**.

4 To enable or disable the setting, use the check box called **Enable copy and paste to and from virtual machine** and click **OK**.

Using Shared Folders

With shared folders you can easily share files among virtual machines and the host computer. You choose a directory on the host or on a network directory that is accessible to the host, and you give it the name you want to use on the guest.

To use shared folders, you must have the current version of VMware Tools installed in the guest operating system and you must configure your virtual machine settings to specify which directories are to be shared.

You can use shared folders with virtual machines running the following guest operating systems and on all supported host systems:

- Windows Server 2003
- Windows XP
- Windows 2000
- Windows NT 4.0
- Windows Vista
- Linux with a kernel version of 2.4 or higher
- Solaris x86 10
- Solaris x86 10 Update 1
- Solaris x86 10 Update 2
- Solaris x86 10 Update 3

The shared folders can be in the host computer's file system or they can be network directories accessible from the host computer.

To set up shared folders for a virtual machine

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Shared Folders**.

4 Click **Add**.

On Windows, clicking **Add** starts the Add Shared Folder wizard. On Linux, it opens the Shared Folder Properties dialog box.

5 Use the following information to help you complete the wizard or Properties dialog box:

- **Name** – Name that appears inside the virtual machine.
- **Host folder** – Path on the host to the directory that you want to share.
- **Enabled** or **Enable this share** – You might want to add a folder to the list without enabling it immediately. In this case, deselect this option to disable the shared folder without deleting it from the virtual machine configuration.

  You can then enable the folder at any time by selecting the check box next to its name in the list. You can alternatively select its name in the list, click **Properties**, and enable the folder in the Properties dialog box.
- **Read-only** – Select this option to prevent the virtual machine from changing the contents of the shared folder in the host file system. Access to files in the shared folder is also governed by permission settings on the host computer.

To change these properties, use the Properties dialog box. On Windows, after you select **Shared Folders** on the **Options** tab, click **Properties**.

6 After the shared folder is created, on the **Shared Folders** settings panel, use one of the check boxes in the **Folder Sharing** section to enable shared folders for this virtual machine.

Select **Enabled until next power off or suspend** if you want to enable folder sharing temporarily, until you shut down, suspend, or restart the virtual machine. You need to select either this option or **Always enabled** if you want to enable or disable specific folders in the **Folders** section.

7 Access the enabled shared folder on the guest operating system:

- On a Windows guest operating system, map a network drive to the `Shared Folders` directory, as described in "Viewing a Shared Folder" on page 175.
- On Linux, shared folders appear under `/mnt/hgfs`. On Solaris, shared folders appear under `/hgfs`.

Enabling and Disabling Shared Folders

This section includes the following procedures:

- "To enable shared folders for virtual machines created by other users" on page 173

  As a security precaution, by default, a shared folder is disabled if it was not created by the user that powers on the virtual machine. This procedure describes how to change the default behavior.

  You might want to enable folder sharing if you created virtual machines with Workstation 4 or 5. Folder sharing for Workstation 4 and 5 virtual machines is also disabled by default.

- "To enable or disable shared folders for specific virtual machines" on page 174

  This procedure describes how to enable folder sharing for a specific virtual machine and also how to enable specific folders.

To enable shared folders for virtual machines created by other users

1 From the **Workstation** menu bar, choose **Edit>Preferences**.

2 On the **Workspace** tab, in the **Virtual Machines** section, select **Enable all shared folders by default**.

  This setting applies to shared folders on all virtual machines that are created by other users, such as appliance developers.

CAUTION Enabling all shared folders might pose a security risk because a shared folder could enable existing programs inside the virtual machine to access the host file system without your knowledge.

To enable or disable shared folders for specific virtual machines

1 For a particular virtual machine, to enable or disable folder sharing:

   a Select the virtual machine.

   The virtual machine can be powered off or powered on.

   b Choose **VM>Settings**.

   The virtual machine settings editor opens.

   c Click the **Options** tab, and select **Shared Folders**.

   d Use the check boxes in the **Folder Sharing** section to specify whether you want to enable or disable shared folders, and click **OK**.

   Select **Enabled until next power off or suspend** if you want to enable folder sharing temporarily, until you shut down, suspend, or restart the virtual machine. You need to select either this option or **Always enabled** if you want to enable or disable specific folders in the **Folders** section.

   On Windows, if you disable shared folders, after you power on this virtual machine and attempt to select a mapped drive to the shared folder, you will receive a message that the connection cannot be made.

   After you enable folder sharing for a virtual machine, you will still not be able to share particular folders unless the specific folders are also enabled, as described in the next step.

2 To enable specific shared folders for a virtual machine:

   a Select the virtual machine.

   The virtual machine can be either powered on or powered off.

   b Choose **VM>Settings>Options>Shared Folders**.

   c In the **Folders** list for the virtual machine, select the check box next to the name of the shared folder that you want to enable.

   Alternatively, select the shared folder and click **Properties**. To make the folder read-only, use the **Properties** button. In the dialog box that appears, select the check box for sharing the folder and click **OK**.

Viewing a Shared Folder

Shared folders appear differently, depending on the guest operating system. The following sections describe viewing shared folders in Windows, Solaris, and Linux guests. You can use shared folders to share any type of file.

WARNING Do not open a file in a shared folder from more than one application at a time. For example, do not open the same file using an application on the host operating system and another application in the guest operating system. If one of the applications writes to the file, some data corruption could occur.

Viewing Shared Folders in a Windows Guest

In a Windows guest operating system, you can view shared folders using desktop icons. Look in **My Network Places>Entire Network** (**Network Neighborhood** for a Windows NT guest, or **Network** for Windows Vista) under **VMware Shared Folders**.

If you have trouble finding a shared folder when using the desktop icon, open Windows Explorer and look in **My Network Places** (or **Network Neighborhood**).

For example, if you specify the name `Test files` for one of your shared folders, you can navigate to it on the guest system by opening **My Network Places>Entire Network>VMware Shared Folders>.host>Shared Folders>Test files**.

You can also go directly to the folder using the UNC path `\\.host\Shared Folders\Test files`.

On the guest system, you can map a shared folder to a drive letter just as you would with a network share. In Windows Explorer, choose **Tools>Map Network Drive**, and browse to the location of the shared folder. The shared folder is located at `\\.host\Shared Folders`.

NOTE If your guest operating system has VMware Tools from Workstation 4.0, shared folders appear as folders on a designated drive letter.

Viewing Shared Folders in a Linux or Solaris 10 Guest

On a Linux virtual machine, shared folders appear under `/mnt/hgfs`. On a Solaris virtual machine, shared folders appear under `/hgfs`.

Viewing Shared Folders on the Host

From the Workstation menu bar, choose **VM>Settings>Options>Shared Folders** to see a list of the shared folders and the directory paths to them.

Shared Folders on Linux Guests: Permissions and Folder Mounting

The version of VMware Tools included in Workstation 6 contains many improvements for Linux guests:

- Performance improvements, as described in "Performance Improvements" on page 176.
- Support for symbolic links if you use a Linux host.
- A new mechanism for mounting shared folders, as described in "Folder Mounting" on page 176. This mechanism allows you to mount one or more directories or subdirectories to any location in your file system.
- Permissions enhancements, as described in "Improved Handling of Permissions" on page 177.

Performance Improvements

Among other performance improvements, host-guest file sharing is integrated with the guest page cache. Files in shared folders are cached for reading and can be written to asynchronously. (You won't see read caching benefits on files that are being actively written to from the guest, however.)

To speed performance, you can also use the `ttl` (time to live) option to the `mount` command. Use this option to specify the interval used by the `hgfs` (host-guest file system) driver for validating file attributes. For example, if you use the following command, attributes are validated every 3 seconds instead of every 1 second, which is the default:

```
mount –o ttl=3 –t vmhgfs .host:/<share> <mountpoint>
```

Be aware, however, that lengthening the interval involves some risk. If something in the host modifies a file's attributes, the guest might not get the modifications as quickly, and it is possible that the file could become corrupted.

Folder Mounting

You can now mount shared folders to other locations besides the default location of `/mnt/hgfs`. You can use the `mount` program to mount all shares, one share, or a subdirectory within a share to any location in your file system. For example:

```
mount –t vmhgfs .host:/ /home/user1/shares
```

mounts all shares to `/home/user1/shares`.

```
mount –t vmhgfs .host:/foo /tmp/foo
```

mounts the share named `foo` to `/tmp/foo`.

```
mount –t vmhgfs .host:/foo/bar /var/lib/bar
```

mounts the subdirectory `bar` within the share `foo` to `/var/lib/bar`.

When you use the `mount` program, the VMware host-guest file system allows you to use VMware-specific options in addition to the standard `mount` syntax. To see usage information host-guest file system options, enter:

```
/sbin/mount.vmhgfs –h
```

NOTE When you install VMware Tools, an entry is made to `etc/fstab` to specify the location of shared folders. You can edit this file to change or add entries.

In previous versions of VMware Tools, when a Linux guest attempted to mount a shared folder, the `vmware–guestd` program attempted to perform the mount. If it failed, the only evidence of the failure was an empty folder.

With the new version of VMware Tools, the Tools services script loads a driver that performs the mount. If the mount fails, you will see a message regarding "Mounting HGFS shares" (*HGFS* means host-guest file system).

The mount might fail if shared folders are disabled or if the share doesn't exist. In this case, receiving the failure message is to be expected. You will no longer be prompted to re-run the VMware Tools configurator (the `vmware–config–tools.pl` file).

Improved Handling of Permissions

Many refinements have been made for Linux guests on both Linux and Windows hosts:

- If you use a Linux host and create files that you want to share with a Linux guest, the file permissions shown on the guest are exactly the same as those on the host.

  Use `fmask` and `dmask` to mask out permissions bits for files and directories.

- If you use a Windows host and create files that you want to share with a Linux guest, read-only files are displayed as having read and execute permission for everyone, and other files are shown as fully writable by everyone.

- If you use a Linux guest to create files that you want to restrict permissions on, use the `mount` program with the following options in the guest: `uid`, `gid`, `fmask`, `dmask`, `ro` (read-only), and `rw` (read-write). Note that `rw` is the default.

  Also note that if you are using a Windows host or a Linux host created with a previous release of Workstation, you can change only the owner permissions. (This behavior is the same as in previous releases.)

Using a Mapped Drive (Windows Only)

You might map a virtual disk to a host as an alternative to using shared folders or copying data between a Windows guest and host. In this case, you can mount a virtual disk in a Windows host file system as a separate mapped drive. Using a mapped drive enables you to connect to the virtual disk without having to go into a virtual machine.

After you map a drive to the virtual disk, you will not be able to power on any virtual machine that uses that disk until you disconnect it from the host. Map only disks for Windows guests. (If you map a disk from a Linux guest, when you attempt to access the disk from your host computer, you will be prompted to format the disk.)

You use Workstation to map the disk to a drive on the host, and to disconnect the drive. If you attempt to use the host's **My Computer>Tools>Disconnect Network Drive** command, you will not see the mapped drive letter in the list of network drives.

NOTE You can mount volumes (partitions) formatted with FAT (12/16/32) or NTFS only. You cannot mount a virtual disk if any of its `.vmdk` files are compressed or have read-only permissions.

To map or disconnect a virtual disk to a drive on the host

1 To map a disk:

   a Make sure that all virtual machines that use the disk are powered off.

   b Choose **File>Map or Disconnect Virtual Disks**.

   c In the Map or Disconnect Virtual Drives dialog box, click **Map**.

   d In the dialog box that appears, click **Browse**, navigate to the desired disk file (`.vmdk` file), and select it. Click **Open**.

   You are returned to the Map a Virtual Disk dialog box.

   e Select the volume you want to map, and select a drive letter that is not yet being used on your host.

CAUTION It is strongly recommended that you leave the check box called **Open file in read-only mode** selected. This setting prevents you from accidentally writing data to a virtual disk that might be the parent of a snapshot or linked clone. Writing to such a disk could make the snapshot or clone unusable.

---

   f Click **OK**.

   The drive now appears in Windows Explorer on your host.

2 From the host, read from or write to files on the mapped virtual disk, as desired.

When you are finished and want to access this disk from a virtual machine again, proceed to the next step.

3 To disconnect the host from the disk:

a Choose **File>Map or Disconnect Virtual Disks**.

b In the Map or Disconnect Virtual Drives dialog box, select the volume that you want to disconnect and click **Disconnect**.

c If you receive an error message asking whether you want to forcibly disconnect, click **Yes**.

d Click **OK**.

You can now power on any virtual machine that uses this disk.

NOTE As an alternative to using the **File>Map or Disconnect Virtual Disks** command, you can select a powered off virtual machine and choose **VM>Settings>Hardware** tab. Select a hard disk and click **Utilities>Map**. The Map Virtual Disk dialog box appears with the corresponding `.vmdk` file already selected. To disconnect, choose **VM>Settings>Hardware**, select the hard disk and click **Utilities>Disconnect**.

Using Devices in a Virtual Machine

Follow the guidelines in this section to add, remove, configure, connect, and disconnect your virtual machine's devices.

Adding, Configuring, and Removing Devices in a Virtual Machine

This section provides general instructions for using the virtual machine settings editor to add and remove devices for a virtual machine and to change device settings. For information about configuring specific types of devices, see Chapter 15, "Connecting Devices," on page 327.

To add, modify, and remove devices in a virtual machine

1 Select the virtual machine. Make sure the virtual machine is powered off.

2 From the Workstation menu bar, choose **VM>Settings**.

The virtual machine settings editor opens.

3 Do one of the following:

- To add a new device to a virtual machine, on the **Hardware** tab, click **Add** and follow the instructions in the New Hardware wizard.
- To change settings for a device, select the device in the left pane and make your changes in the settings panel on the right. Click **OK** to save your changes and close the virtual machine settings editor.
- To remove a device, click the name of the device and click **Remove**. Click **OK** to close the virtual machine settings editor.

Connecting and Disconnecting Removable Devices

You can configure a number of removable devices for use in a virtual machine, including floppy drives, DVD/CD-ROM drives, USB devices, and Ethernet adapters.

For information about how to configure specific devices, see Chapter 15, "Connecting Devices," on page 327 and Chapter 9, "Using Disks," on page 195.

To connect to and disconnect from a removable device

1 Select the virtual machine.

Make sure the virtual machine is powered on.

2 Do one of the following:

- From the Workstation menu bar, choose **VM>Removable Devices><Device_Name>** and then **Connect** or **Disconnect**.

  If you choose **Edit**, a dialog box appears. Make the desired changes and click **OK**. If you need assistance, click the **Help** button to display online help.
- From the Workstation menu bar, choose **VM>Settings**, and select the device in the left pane. In the settings panel on the right, in the **Device status** section, click **Connected**, and click **OK**.
- Right-click the device icon in the notification area of the window and choose **Connect** or **Disconnect**.

Creating a Screen Shot of a Virtual Machine

You can capture a screen shot of a virtual machine. From the Workstation menu bar, choose **VM>Capture Screen**. You can save this image as a bitmap (`.bmp`) file on a Windows host or as a portable network graphics (`.png`) file on a Linux host.

Creating a Movie of a Virtual Machine

You can capture a movie of your activity within a virtual machine. Workstation saves this image as an `.avi` file on the host.

NOTE If instead of creating a movie you want to actually record the activity of the virtual machine, see "Recording Activity of a Virtual Machine (Experimental)" on page 237. You might want to record a virtual machine for debugging purposes or to exactly reproduce the steps that cause a certain behavior.

To capture a movie of virtual machine activity

1 From the Workstation menu bar, choose **VM>Capture Movie**.

A Save File dialog box appears.

2 Enter information for your movie and click **Save**.

Use the following guidelines:

- The **Quality** setting determines the compression and therefore the file size of the resulting movie.
- If you select **Omit frames in which nothing occurs**, the movie will include only those periods of time when something is actually happening in the virtual machine. This reduces the file size and length of the movie.

While movie capture is active, a red circle (a virtual LED) appears in the notification area of the window.

3 In the virtual machine, perform the actions you want to have appear in the movie.

4 To stop the movie, do one of the following:

- Choose **VM>Stop Movie Capture**.
- Right-click the movie capture icon in the notification area and choose **Stop Movie Capture**. The red circle disappears from the status bar, and your movie is saved.

To play the movie back

1 On Windows machines, make sure VMware CODEC (coder-decoder) is installed.

This CODEC is automatically installed on with Workstation on Windows hosts. A separately downloadable installer is also available for playback of movies on Windows machines without Workstation. Go to http://www.vmware.com/download/ws/drivers_tools.html.

Although you can capture a movie on Linux, you need to play it back on a Windows machine.

2 Play back your movie in any compatible media player.

Using a VNC Client for Remote Connections to a Virtual Machine

VNC (Virtual Network Computing) software makes it possible to view and interact with one computer from any other computer or mobile device anywhere on the Internet. VNC software is cross-platform, allowing remote control between different types of computers. For example, you can use VNC to view a Linux machine on your Windows PC. Open-source versions of VNC are freely and publicly available.

You can use Workstation to set a virtual machine to act as a VNC server, and users on other computers can install a VNC client (also called a VNC viewer) to connect to the virtual machine. After you set up a virtual machine as a VNC server, you can see a list of users who are remotely connected to the virtual machine and find out how long they have been connected. To see this list, you can either choose **VM>Connected Users** from the Workstation menu bar, or you can right-click the VNC icon in the status bar.

Workstation does not need to be running when VNC connections are made. Only the virtual machine needs to be running, and it can be running in the background. This section provides instructions for configuring the virtual machine to act as a VNC server. You do not need to install any specialized VNC software in the guest.

About VNC Port Numbers

When configuring VNC, as described later in this section, if you want to connect to more than one virtual machine on the same host with a VNC client, you must specify a unique port number for each virtual machine. VMware suggests you use a port number in the range from 5901 to 6001.

You can use any port number, but keep in mind that certain port numbers are used by other applications, and some port numbers are privileged (meaning only the root or Administrator user can listen). For example, the VMware Management Interface uses ports 8333 and 8222; on Linux, only root can listen to ports up to port number 1024. Conflicts can occur if you specify a port in use by another application.

Ensuring Proper Display on the Client

For the VNC client, be sure to specify the following settings before you connect to a virtual machine. Make sure the client is set for hextile encoding, and make sure the client is set to use all colors. For example, if you use RealVNC Viewer, under the Preferred Encoding option, select **Hextile**, and under the Colour Level option, select **Full (all available colours)**.

The following issues are known to occur when you connect to virtual machines with a VNC client:

- You cannot take or revert to snapshots.
- You cannot change the power state of the virtual machine; that is, you cannot power on, power off, suspend, or resume. You can shut down the guest operating system, however, which might power off the virtual machine.
- You cannot copy and paste text between the host and guest operating system.
- You cannot configure the virtual machine with the virtual machine settings editor, and neither can you upgrade VMware Tools.
- Remote display does not work well if you are also using the 3D feature. This feature is described in "Experimental Support for Direct3D" on page 320.

To set up VNC connections to a virtual machine

1 Make sure the guest operating system has VMware tools installed.

2 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

3 Choose **VM>Settings**.

The virtual machine settings editor opens.

4 Click the **Options** tab, and select **Remote Display**.

5 Click **Enable remote display**, specify a port number, and if desired, set a password for connecting to the virtual machine from a VNC client.

The password can be up to 8 characters long. Because it is not encrypted when it is sent by the VNC client, do not use a password that you use for other systems.

NOTE After remote display is enabled and users connect to the virtual machine with a VNC client, you can use the **View Connected Users** button on this tab to see a list of the connected users.

---

6 Click **OK**.

7 To make sure the virtual machine is configured properly, try connecting to it with a VNC client:

a On a local or remote computer, start a VNC client.

You can use any VNC client, but not a Java viewer in a browser. If you need to download and install a VNC client, one of the many Web sites where you can buy or get one for free is http://www.realvnc.com/download.html.

b When prompted for the VNC server name, enter the name or IP address of the host computer and the port number you specified in step 5.

Use the format:

```
<machine_name>:<port_number>
```

c If a password is required, enter one when prompted.

This is the same password you set in step 5.

For information about mapping the keyboard to various languages, see "Specifying a Language Keymap for VNC Clients" on page 343.

Moving and Sharing Virtual Machines

8

This chapter provides information on how to move your virtual machines from one host to another, or elsewhere on the same host, plus recommendations on how to share virtual machines with other users. This chapter includes the following topics:

- "Virtual Machine Identifier: UUID" on page 185
- "Moving a Virtual Machine" on page 188
- "Moving an Older Virtual Machine" on page 191
- "Sharing Virtual Machines with Other Users" on page 191
- "Moving Linked Clones" on page 191
- "Sharing Virtual Machines with VMware Player" on page 192

NOTE When you move a virtual machine to a new host computer or to a different directory on the same host computer—or when you rename a directory in the path to the virtual machine's configuration file—Workstation generates a different MAC address for the virtual Ethernet adapter. For additional information, see "Maintaining and Changing the MAC Address of a Virtual Machine" on page 294.

Virtual Machine Identifier: UUID

To ensure all virtual machines are identified properly, each virtual machine is automatically assigned a universal unique identifier (UUID).

Use the UUID of a virtual machine for system management in the same way you use the UUID of a physical computer. The UUID is stored in the SMBIOS system information descriptor. It can be accessed by standard SMBIOS scanning software, such as SiSoftware Sandra or the IBM utility smbios2.

This UUID is generated when you initially power on the virtual machine. As long as you do not move or copy the virtual machine to another location, the UUID remains constant. To set a specific UUID, see "Specifying a UUID for a Virtual Machine" on page 187.

UUID Options When You Move a Virtual Machine

When you power on a virtual machine that was moved or copied to a new location, the following message appears:

```
The virtual machine's configuration file has changed its location since its
last power-on. Do you want to create a new unique identifier (UUID) for the
virtual machine, or keep the old one?
```

You have four options: **Create**, **Keep**, **Always Create**, **Always Keep**. The proper selection depends on the cause for the changed UUID:

- **Keep** – If the virtual machine was moved rather than copied, you can choose to keep the UUID.
- **Create** – If the virtual machine was copied to a new location, you should create a new UUID so that the copy will have its own UUID and not conflict with that of the original virtual machine. If you are not sure which option to choose, the safest option is **Create**.
- **Always Create** – If the original virtual machine is being used as a master copy for more virtual machines, you can create a new UUID the first time you power on each copy. After you configure the virtual machine and are ready to make it a master copy, move it to a new location and power it on. When the message appears after you power on, select **Always Create**. The virtual machine is set up to create a new UUID every time it is moved. Power off the virtual machine and begin using it as a master copy by copying the virtual machine files to other locations.

  NOTE You can avoid having to use this process of creating a master copy that always creates a new UUID if you simply clone the virtual machine rather than copy it.

- **Always Keep** – If you intend to move the virtual machine numerous times and want to keep the same UUID each time the virtual machine moves, select **Always Keep**.

NOTE To change the **Always Keep** or **Always Create** setting, power off the virtual machine and edit its configuration file (`.vmx`). Delete the line that contains:

```
uuid.action = "create"
```

or

```
uuid.action = "keep"
```

Or, conversely, if you want to specify to always keep or always create the UUID and *not* prompt the user to choose a setting when first powering on the virtual machine, edit the configuration file and add the appropriate line for `uuid.action`.

Suspending and resuming a virtual machine does not trigger the process that generates a UUID. Thus, the UUID in use at the time the virtual machine was suspended remains in use when the virtual machine is resumed, even if it has been copied or moved. However, the next time the virtual machine is rebooted, the message appears, so you can choose to create a new UUID or keep the existing one.

Specifying a UUID for a Virtual Machine

The UUID is a 128-bit integer. The 16 bytes of this value are separated by spaces, except for a dash between the eighth and ninth hexadecimal pairs. An example UUID looks like this:

```
00 11 22 33 44 55 66 77–88 99 aa bb cc dd ee ff
```

You might want to assign a specific UUID to the virtual machine. To do this, you need to override the generated UUID value. Power off the virtual machine and edit its configuration file (`.vmx`) to set the value of the UUID parameter. Use a text editor to edit the configuration file. The format for the line is:

```
uuid.bios = <uuidvalue>
```

The UUID value must be surrounded by quotation marks. A sample configuration line looks like:

```
uuid.bios = "00 11 22 33 44 55 66 77–88 99 aa bb cc dd ee ff"
```

After adding this line to the configuration file, power on the virtual machine. The new UUID is used when the virtual machine boots.

Moving a Virtual Machine

You can take a virtual machine that was created by using Workstation and move it to a different computer or to a different location on the same computer. You can even move your virtual machine to a host with a different operating system. For example, you can move a virtual machine from a Windows host to a Linux or VMware ESX Server host.

In general, moving a virtual machine means moving the files that make up the virtual machine. The path names for all files associated with a Workstation virtual machine are relative, meaning the path to each file is relative to the virtual machine directory. For example, if you are in the virtual machine directory, the relative path to the virtual disk file is `<machine name>.vmdk`.

CAUTION Always make backup copies of all the files in your virtual machine's directory before you start a process like this.

Hosts with Different Hardware

The guest operating system might not work correctly if you move a virtual machine to a host with significant hardware differences, such as from a 64-bit host to a 32-bit host or from a multiprocessor host to a uniprocessor host. This section provides details.

Moving Between 64-Bit and 32-Bit Hosts

You can move a virtual machine from a 32-bit host to a 64-bit host but not from a 64-bit host to a 32-bit host.

NOTE Workstation supports 64-bit guest operating systems only in Workstation versions 5.5 and later, and only on host machines with supported processors. When you power on a virtual machine with a 64-bit guest operating system, Workstation performs an internal check: If the host CPU is not a supported 64-bit processor, you cannot power on the virtual machine. For the list of processors Workstation supports for 64-bit guest operating systems, see the *VMware Guest Operating System Installation Guide*, available from the **Help** menu.

Moving Between Multiprocessor and Uniprocessor Hosts

For all supported configurations of 32-bit and 64-bit host and guest operating systems running on multiprocessor host machines, versions 5.5 and later of Workstation support two-way virtual symmetric multiprocessing (SMP). This enables you to assign two virtual processors to a virtual machine. This is supported only for host machines with at least two logical processors. For more information, see "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 365.

NOTE If the host is a uniprocessor machine, assigning two processors is neither supported nor recommended. A warning message will appear. You can disregard this message and assign two processors to the virtual machine, but when you finish creating the virtual machine, you will not be able to power it on unless you move it to a host machine with at least two logical processors.

Opening a Virtual Machine Created in ESX Server That Has More Than Two Processors

You can use Workstation 5.5 or higher, running on a multiprocessor host machine, to open a virtual machine created in VMware ESX Server that has one or more virtual processors. However, in Workstation you cannot power on or resume a virtual machine that has more than two virtual processors assigned, even if more processors were assigned when the virtual machine was created in ESX Server.

You can see this setting in the virtual machine's summary view or by using the virtual machine settings editor.

To open an ESX virtual machine that has more than two processors

1 From the Workstation menu bar, choose **VM>Settings>Hardware>Processors**, and note that **Number of Processors** is set to **Other (x)**, where **x** is the number of processors originally assigned in ESX Server.

   Workstation preserves this original configuration setting for the number of processors, even though two is the maximum number of processors supported.

2 Change this setting to two processors so that you can power on the virtual machine in Workstation.

   Note that once you commit a change to this setting, the original setting for number of processors is discarded, and no longer appears as an option in the virtual machine settings editor.

Moving a Virtual Machine to a New Host or on the Same Host

Use the procedure in this section either to move the virtual machine to a different location on the same host or to move it to a new host. This section applies to virtual machines created with all these VMware products:

- Workstation 4.x, 5.x, 6.x
- GSX Server 3.x
- VMware Server 1.x
- ESX Server 2.x or 3.x
- VMware ACE 1.x, 2.x

See "Legacy Virtual Disks" on page 220 for more information on virtual machine formats from older VMware products.

To move a virtual machine

1 Make sure that all the virtual machine files are stored in the virtual machine directory.

For example, if you configured the working directory to be located in a different location on the host, move it into the virtual machine directory and use the virtual machine settings editor (**VM>Settings>Options>General**) to point to this location.

If the virtual machine you want to move is a linked clone, see "Moving Linked Clones" on page 191.

2 Shut down the guest operating system and power off the virtual machine.

If the virtual machine is suspended, resume it and then shut it down.

3 Copy all the files in the virtual machine directory to the new location.

To move the virtual machine's files to another host, if you don't have a network connection to the new host, use a shared network directory, burn the files onto a DVD, or use some other storage media that has enough disk space.

NOTE For a description of the files that you are moving, see "Files That Make Up a Virtual Machine" on page 108.

---

4 Start Workstation and open the virtual machine in its new location, as follows: Choose **File>Open**, and browse to the virtual machine's configuration (`.vmx`) file.

If the virtual machine is an ESX Server virtual machine with more than two processors, see "Moving SMP Virtual Machines Between Workstation and ESX Server" on page 366.

NOTE If you are moving the virtual machine to a different location on the same host, remove the virtual machine from the **Favorites** list and add it back using the new location.

---

5 When you are certain that the virtual machine in the new location works correctly, you can delete the virtual machine files from the old location, if desired.

If the virtual machine in the new location is not working correctly, examine the virtual machine in the original location to find out whether you missed copying some files, perhaps because they were outside of the virtual machine directory.

Use the virtual machine settings editor (**VM>Settings>Hardware**) to select devices and find out whether any associated files point to locations that cannot be accessed from the new virtual machine.

Moving an Older Virtual Machine

If you created a virtual machine by using Workstation 2.x or 3.x, you must upgrade it to at least version 4. Workstation 6 does not support Workstation 2 or 3 virtual machines.

Moving Linked Clones

You can move a linked clone as you would an ordinary Workstation virtual machine. However, if you move a linked clone (or if you move its parent virtual machine), make sure the clone can access the parent virtual machine, for example, by using a shared directory or networked file server.

CAUTION You cannot power on a linked clone if Workstation cannot locate the original virtual machine.

Sharing Virtual Machines with Other Users

If you want other users to be able to access your virtual machines, consider the following points:

- Only one user can run a virtual machine at a time. Other users can also share a virtual machine by making a linked clone of it. A linked clone is a copy that uses the same virtual disks as the parent virtual machine it was copied from. See "Cloning a Virtual Machine" on page 245.
- On Windows hosts, relocate the virtual machine files to a directory that is accessible to all appropriate users. The default location for a Windows host is not typically accessible to other users:
  - On Windows XP: `C:\Documents and Settings\<user name>\My Documents\My Virtual Machines`
  - On Windows Vista: `C:\Users\<user name>\Documents\Virtual Machines`

  When you configure the virtual machine in the New Virtual Machine wizard, you can specify a location for the virtual machine elsewhere on your system or on a network volume.

- On Linux hosts, permissions for the virtual machine files should be set for other users according to how you want them to use the virtual machine.

  Permissions settings are especially important for the configuration file (`.vmx`) and virtual disks (`.vmdk`). For example, if you want users to run a virtual machine but not be able to modify its configuration, do not make the configuration file writable.

Sharing Virtual Machines with VMware Player

VMware Player is a free application that opens and plays virtual machines created with other VMware products. On Windows hosts, Player also opens and plays Microsoft Virtual PC and Virtual Server virtual machines and Symantec LiveState Recovery and system images.

VMware Player is included with Workstation versions 5.5 and later. "Standalone" Player is also freely available for download at:

http://www.vmware.com/products/player/

VMware Player makes your VMware virtual machines accessible to colleagues, partners, customers, and clients who do not own other VMware products.

NOTE Use of VMware Player is subject to the VMware Player End User License terms, and no support (including Support and Subscription) will be provided by VMware for VMware Player. For self-help resources, see the VMware Player FAQ at www.vmware.com/products/player/faqs.html.

Also check the VMware Player Discussion Forum on the VMware VMTN Web site, at www.vmware.com/community/forum.jspa?forumID=123. The forum is a site where VMTN members exchange information, questions, and comments with each other regarding VMware products, services, and product support issues.

Running VMware Player

VMware Player is included in the Workstation distribution. When you install Workstation, the application file, `vmplayer.exe` (Windows) or `vmplayer` (Linux), is stored with the rest of your Workstation program files.

For instructions on using and configuring VMware Player, see the online help provided in VMware Player (from the VMware Player menu bar, choose **VMware Player>Help**).

To run VMware Player

1 Open VMware Player, either from the graphical user interface (GUI) or from the command line:

- From the GUI, on Windows, select **VMware Player** from the **Start>Programs>VMware** menu. In a Linux X session, select **VMware Player** from the corresponding program menu, such as the **System Tools** menu.
- From the command line, open a command prompt, and enter one of the following commands:
  - On Windows: `<path>vmplayer.exe`

    where `<path>` is the appropriate path on your system to the application file.
  - On Linux: `vmplayer &`

2 Open a virtual machine.

When you launch the player, it displays a Welcome page that gives you the option of browsing to a virtual machine file, opening a recently used virtual machine, or downloading a virtual appliance from the VMTN (VMware Technology Network) Web site.

To close VMware Player

Do one of the following:

- Shut down the guest operating system in the virtual machine. The player closes after the guest operating system shuts down.
- In VMware Player, choose **VMware Player>Exit** (Windows) or **Player>Quit** (Linux). Player will either suspend or power off the virtual machine, depending on the preference you set for exit behavior in **Player>Preferences**.

Setting Up Virtual Machines for Use with VMware Player

Take care when you create virtual machines that you intend to be distributed and played by VMware Player. Configure the virtual machine for maximum compatibility with all expected host machines and systems. Because the Player's configuration options are limited, users are limited in their ability to make changes in a virtual machine so that it is compatible with their host systems.

Following are recommendations to help you configure virtual machines for maximum compatibility with VMware Player and with the widest range of host machines:

- Determine which virtual devices are actually required, and don't include any that are not needed or useful for the software you are distributing with the virtual machine and VMware Player. For example, generic SCSI devices are extremely unlikely to be appropriate.
- To connect a physical device to a virtual device, use the **Auto detect** options when configuring the virtual machine. The **Auto detect** options allow the virtual machine to adapt to the user's system, and they work whether the host operating system is Windows or Linux. Users who have no physical device at all will receive a warning message.
- To connect a CD-ROM or floppy to an image file that you ship with the virtual machine, make sure the image file is in the same directory as the virtual machine. This way, a relative path, rather than an absolute path, is used.
- For both a physical CD-ROM and an image, provide two virtual CD-ROM devices in the virtual machine. VMware Player does not provide a way in the user interface to switch a single CD-ROM device between a physical CD-ROM and an image. This also means that if you want to ship multiple images, the user will not be able to switch between them.
- Choose a reasonable amount of memory to allocate to the virtual machine. If the user's host machine does not have enough physical memory to support the memory allocation, the player cannot power on the virtual machine.
- Install VMware Tools in the virtual machine. VMware Tools significantly improves the user's experience working with the virtual machine.
- Choose a reasonable screen resolution for the guest. A user is likely to find it easier to increase the resolution manually than to deal with a display that exceeds the user's physical screen size.
- Some host operating systems do not support CD-ROMs in non-legacy mode. To ensure that CD-ROMs work properly in virtual machines that you intend to be distributed and played on VMware Player, configure CD-ROM devices in legacy mode. For more information, see "Legacy Emulation for DVD and CD Drives" on page 212.
- Make an appropriate setting in **VM>Settings>Options>Snapshots>When powering off.** Set this option to **Just power off** or **Revert to snapshot**. VMware Player does not allow taking snapshots.

  The option **Revert to snapshot** is useful if you want to distribute a demo that resets itself to a clean state when powered off.

9 Using Disks

This chapter provides information on configuring your virtual machine's hard disk storage so it best meets your needs. This chapter includes the following topics:

- "Overview of Disk Storage in a Virtual Machine" on page 195
- "Maintenance Tasks for Virtual Disks" on page 199
- "Adding Virtual and Physical Disks to a Virtual Machine" on page 202
- "Using VMware Virtual Disk Manager" on page 214
- "Using Dual-Boot Computers with Virtual Machines" on page 220
- "Legacy Virtual Disks" on page 220

To map an existing virtual disk drive to a Windows host machine, rather than adding it to a virtual machine, see "Using a Mapped Drive (Windows Only)" on page 178.

Overview of Disk Storage in a Virtual Machine

Like a physical computer, a VMware Workstation virtual machine stores its operating system, programs, and data files on one or more hard disks. Unlike a physical computer, Workstation gives you options for undoing changes to the virtual machine's hard disk.

The New Virtual Machine wizard creates a virtual machine with one disk drive. Use the virtual machine settings editor (by choosing **VM>Settings** from the Workstation menu bar) to add more disk drives to your virtual machine, to remove disk drives from your virtual machine, and to change certain settings for the existing disk drives.

This section describes the choices you can make in setting up hard disk storage for your virtual machine.

Virtual Disks

In most cases, it is best to configure virtual machines to use virtual hard disks rather than physical hard disks. A virtual disk is a file or set of files that appears as a physical disk drive to a guest operating system. The files can be on the host machine or on a remote computer. When you configure a virtual machine with a virtual disk, you can install a new operating system onto the virtual disk without repartitioning a physical disk or rebooting the host.

Portability

A key advantage of virtual disks is their portability. Because the virtual disks are stored as files on the host machine or a remote computer, you can move them easily to a new location on the same computer or to a different computer. You can also use Workstation on a Windows host to create virtual disks, and then move them to a Linux computer and use them under Workstation for Linux, and the reverse. For more information, see "Moving and Sharing Virtual Machines" on page 185.

Disk Size and Files

Virtual disks can be as large as 950GB (IDE or SCSI). Depending on the size of the virtual disk and the host operating system, Workstation creates one or more files to hold each virtual disk. These files include information that gets written to a virtual machine's hard disk, such as the operating system, the program files, and the data files. The virtual disk files have a `.vmdk` extension.

By default, the actual files used by the virtual disk start out small and grow to their maximum size as needed. The main advantage of this approach is the smaller file size. Smaller files require less storage space and are easier to move if you want to move the virtual machine to a new location. However, it takes longer to write data to a disk configured in this way.

You can also configure virtual disks so all the disk space is allocated at the time the virtual disk is created. This approach provides enhanced performance and is useful if you are running performance-sensitive applications in the virtual machine.

Regardless of whether you allocate all disk space in advance, you can configure the virtual disk to use a set of files limited to 2GB per file. Use this option if you plan to move the virtual disk to a file system that does not support files larger than 2GB.

Lock Files

A running virtual machine creates lock files to prevent consistency problems on virtual disks. If the virtual machine did not use locks, multiple virtual machines might read and write to the disk, causing data corruption.

Lock files are used to protect a virtual machine and are created in sub-directories with a `.lck` suffix. The locking sub-directories reside in the same directory as the virtual machine's `.vmdk` files. A locking sub-directory and lock file are created for `.vmdk` files, `.vmx` files, and `.vmem` files.

As of the Workstation 6 release, a unified locking method is used on all host operating systems, so files shared between them are fully protected. For example, if one user on a Linux host tries to power on a virtual machine that is already powered on by another user with a Windows host, the lock files will prevent the second user from powering on the virtual machine.

When a virtual machine powers off, it removes the locking sub-directories and their lock files. If it cannot remove these locking controls, one or more stale lock files might be left. For example, if the host machine crashes before the virtual machine has a chance to remove its locking controls, stale lock files remain.

When the virtual machine starts again, it scans any locking sub-directories for stale lock files and, when possible, removes them. A lock file is considered stale if both of the following conditions are true:

- The lock file was created on the same host that is now running the virtual machine.
- The process that created the lock is no longer running.

If those two conditions are true, the virtual machine can safely remove the stale lock or locks. If either of those conditions is not true, a dialog box appears, warning you that the virtual machine cannot be powered on. If you are sure it is safe to do so, you can delete the locking directories and their lock files manually.

Physical disk partitions are also protected by locks. However, the host operating system is not aware of this locking convention and thus does not respect it. For this reason, VMware strongly recommends that the physical disk for a virtual machine not be installed on the same physical disk as the host operating system.

Disk Type: IDE Versus SCSI

Virtual disks can be set up as IDE disks for any guest operating system. They can be set up as SCSI disks for any guest operating system that has a driver for the LSI Logic or BusLogic SCSI adapter available in a Workstation virtual machine. You determine which SCSI adapter to use at the time you create the virtual machine.

NOTE To use SCSI disks in a 32-bit Windows XP virtual machine, you need a special SCSI driver available from the download section of the VMware Web site at www.vmware.com/download. Follow the instructions on the Web site to use the driver with a fresh installation of Windows XP.

A virtual disk of either type can be stored on either type of physical hard disk. That is, the files that make up an IDE virtual disk can be stored on either an IDE hard disk or a SCSI hard disk. So can the files that make up a SCSI virtual disk. They can also be stored on other types of fast-access storage media.

Physical Disks

In some circumstances, you might need to give your virtual machine direct access to a physical hard drive on your host computer. A physical disk directly accesses an existing local disk or partition. You can use physical disks if you want Workstation to run one or more guest operating systems from existing disk partitions.

NOTE Only expert users should attempt physical disk configurations.

Although virtual disks are limited to 950GB, physical disks can be set up on both IDE and SCSI devices of up to 2TB capacity. Booting from an operating system already set up on an existing SCSI disk or partition is currently not supported.

Also, on Windows Vista hosts, you cannot use the system partition, or the physical disk that contains it, in a virtual machine.

CAUTION If you run an operating system natively on the host computer, and switch to running it inside a virtual machine, the change is like pulling the hard drive out of one computer and installing it in a second computer with a different motherboard and other hardware. The steps you take depend on the operating system you want to use inside the virtual machine. For details, see the VMware technical note *Dual-Boot Computers and Virtual Machines*.

You can also create a new virtual machine that uses a physical disk. For details, see "Using Physical Disks in a Virtual Machine" on page 205. In most cases, however, it is better to use a virtual disk. If you use physical disk, the `.vmdk` file stores information about the physical disk or partition used by the virtual machine.

After you configure a virtual machine to use one or more partitions on a physical disk, don't modify the partition tables by running `fdisk` or a similar utility in the guest operating system.

If you use `fdisk` or a similar utility on the host operating system to modify the partition table of the physical disk, you must re-create the virtual machine's physical disk. All files that were on the physical disk are lost when you modify the partition table.

WARNING Do not use a physical disk to share files between host and guest operating systems. It is not safe to make the same partition visible to both host and guest. You can cause data corruption if you do this. To share files between host and guest operating systems, use shared folders. For details, see "Using Shared Folders" on page 171.

Maintenance Tasks for Virtual Disks

This section contains the following topics:

- "Defragmenting Virtual Disks" on page 199
- "Shrinking Virtual Disks" on page 200

Defragmenting Virtual Disks

Like physical disk drives, virtual disks can become fragmented. Defragmenting disks rearranges files, programs, and unused space on the virtual disk so that programs run faster and files open more quickly. Defragmenting does not reclaim unused space on a virtual disk. To reclaim unused space, shrink the disk.

NOTE The defragmentation process requires free working space on the host computer's disk. If your virtual disk is contained in a single file, for example, you need free space equal to the size of the virtual disk file. Other virtual disk configurations require less free space.

To defragment a virtual disk

1 Run a disk defragmentation utility inside the guest operating system.

For example, in a virtual machine with a Windows XP guest operating system, use the Windows XP Disk Defragmenter tool from within the virtual machine.

2 Defragment the virtual disk by using the Workstation defragmentation tool:

a Select the virtual machine.

Make sure the virtual machine is powered off.

b Choose **VM>Settings**.

The virtual machine settings editor opens.

c Select **Hard Disk**, and do one of the following:

- On Linux hosts, click **Defragment**.
- On Windows hosts, click the **Utilities** button, and choose **Defragment**.

d When the process is finished, click **OK** to close the dialog box.

NOTE This capability works only with "growable" virtual disks, not physical disks or virtual disks whose disk space was preallocated.

---

3 Run a disk defragmentation utility on the host computer.

Defragmenting disks can take considerable time.

Shrinking Virtual Disks

If you have a virtual disk that grows as data is added, you can shrink it as described in this section. If you allocated all the space for your virtual disk at the time you created it, you cannot shrink it.

Shrinking a virtual disk reclaims unused space in the virtual disk. If there is empty space in the disk, this process reduces the amount of space the virtual disk occupies on the host drive.

Restrictions and Requirements

Shrinking a disk requires free disk space on the host equal to the size of the virtual disk you are shrinking.

Shrinking applies only to virtual disks. You cannot shrink physical disks or CD-ROMs.

In some configurations, it is not possible to shrink virtual disks. If your virtual machine uses such a configuration, the **Shrink** tab in the VMware Tools control panel displays information explaining why you cannot shrink your virtual disks.

For example, you cannot shrink a virtual disk if:

- You preallocated disk space when you created the disk.
- The virtual machine has any snapshots. To delete a snapshot, choose **VM>Snapshot>Snapshot Manager**. Select the snapshot and click the **Delete** button (on Windows) or icon (on the snapshot toolbar on Linux).
- The virtual disk is a linked clone or is the parent of a linked clone.
- The virtual machine contains physical disks.

- The virtual disk is stored on a CD-ROM.
- The virtual disk is an independent disk in non-persistent mode.

  You can change the mode of a virtual disk before the virtual machine is powered on. See "Excluding Virtual Disks from Snapshots" on page 230 for a discussion of independent disks.

The Shrinking Process

Shrinking a disk is a two-step process:

1 **Wiping** – Takes place in the guest operating system. VMware Tools reclaims all unused portions of disk partitions (such as deleted files) and prepares them for shrinking. During this phase, you can still interact with the virtual machine.

2 **Shrinking** – Takes place on the host. Workstation reduces the size of the disk's files by the amount of disk space reclaimed in the wipe process. During this phase, the virtual machine is stopped, and you cannot interact with it.

To shrink a virtual disk

1 Launch the VMware Tools control panel, as appropriate for your operating system:

- For a Windows guest, click the **VMware Tools** icon in the notification area of the taskbar, or choose **Start>Settings>Control Panel**, then double-click **VMware Tools**.
- For a Linux, Solaris, or FreeBSD guest, become root and run `vmware-toolbox`.

  If you shrink disks as a nonroot user you cannot wipe the parts of the virtual disk that require root-level permissions.

2 Click the **Shrink** tab.

3 Select the virtual disks you want to shrink and click **Prepare to Shrink**.

A dialog box tracks the progress of the wiping process.

NOTE If you deselect some partitions, the whole disk still shrinks. However, those partitions are not wiped for shrinking, and the shrink process does not reduce the size of the virtual disk as much as it would with all partitions selected.

---

4 When VMware Tools finishes wiping the selected disk partitions, and you are prompted to shrink disks now, click **Yes**.

A dialog box tracks the progress of the shrinking process. Shrinking disks can take considerable time.

5 Click **OK** to finish.

Adding Virtual and Physical Disks to a Virtual Machine

Workstation 6 virtual machines can use up to 4 IDE devices and up to 60 SCSI devices. Any of these devices can be a virtual or physical hard disk or DVD or CD-ROM drive.

This section provides instructions for the following procedures:

- "Adding a New Virtual Disk to a Virtual Machine" on page 202
- "Adding an Existing Virtual Disk to a Virtual Machine" on page 204
- "Removing a Virtual Disk from a Virtual Machine" on page 204
- "Using Physical Disks in a Virtual Machine" on page 205

Many other SCSI devices can be connected to a virtual machine by using the host operating system's generic SCSI driver. See "Connecting to a Generic SCSI Device" on page 357.

To map an existing virtual disk drive to a Windows host machine, rather than adding it to a virtual machine, see "Using a Mapped Drive (Windows Only)" on page 178.

Adding a New Virtual Disk to a Virtual Machine

Virtual disks are stored as files on the host computer or on a network file server. It does not matter whether the physical disk that holds the files is IDE or SCSI. A virtual IDE drive or a virtual SCSI drive can be stored on an IDE drive or on a SCSI drive.

Use the virtual machine settings editor to add a new virtual disk to your virtual machine, as described in the procedure that follows. To add an existing virtual disk to the virtual machine, see "Adding an Existing Virtual Disk to a Virtual Machine" on page 204.

NOTE If you have a Windows NT 4.0 guest with a SCSI virtual disk, you cannot add both an additional SCSI disk and an IDE disk to the configuration.

To add a new virtual disk to a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add** to start the Add Hardware wizard.

4 On the Hardware Type page, select **Hard Disk** and click **Next**.

5 On the Select a Disk page, select **Create a new virtual disk** and click **Next**.

6 On the Select a Disk Type page, choose whether you want the virtual disk to be an IDE disk or a SCSI disk.

Information about the requirements of creating a SCSI disk appears in "Disk Type: IDE Versus SCSI" on page 197.

7 Also on the Select a Disk Type page, if you want to exclude disks from snapshots, in the **Mode** section, select **Independent** for the mode and choose one of the following options:

- **Persistent** – Changes are immediately and permanently written to the disk.
- **Nonpersistent** – Changes to the disk are discarded when you power off or revert to a snapshot.

For more information, see "Using Snapshots" on page 225.

8 On the Specify Disk Capacity page, set the capacity for the new virtual disk.

You can set a size between 0.1GB and 950GB for a virtual disk. For more information about the choices, see "Disk Size and Files" on page 196.

9 On the Specify Disk File page, accept the default filename and location or browse to a different location.

10 Click **Finish**.

The wizard creates the new virtual disk. It appears to your guest operating system as a new, blank hard disk.

11 Use the guest operating system's tools to partition and format the new drive for use.

Adding an Existing Virtual Disk to a Virtual Machine

You can reconnect an existing virtual disk that has been removed from a virtual machine.

To add an existing virtual disk to a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add** to start the Add Hardware wizard.

4 On the Hardware Type page, select **Hard Disk** and click **Next**.

5 On the Select a Disk page, select **Use an existing virtual disk** and click **Next**.

6 On the Select an Existing Disk page, enter the path name and filename for the existing disk file, or browse to the file and click **OK**.

If you want to map an existing virtual disk drive to a Windows host machine, see "Using a Mapped Drive (Windows Only)" on page 178.

Removing a Virtual Disk from a Virtual Machine

Use the virtual machine settings editor to disconnect a virtual disk from a virtual machine. The **Remove** command described in the following procedure does not delete files from the host file system.

You need to disconnect a virtual disk if you want to map the disk to a Windows host machine. You might want to map the disk to a host as an alternative to copying the data back and forth between guest and host. In this case, you remove the disk from the virtual machine, as described in this section, map it to the host, as described in "Using a Mapped Drive (Windows Only)" on page 178, and add it back to the virtual machine when you are finished.

To delete virtual disk files, you need to delete them manually. You might, however, want to retain the virtual disk files so that you can reconnect the virtual disk to the virtual machine, as described in "Adding an Existing Virtual Disk to a Virtual Machine" on page 204.

To remove a virtual disk from a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Select the virtual disk you want to remove and click **Remove**.

The virtual disk is disconnected from virtual machine.

Using Physical Disks in a Virtual Machine

In some situations, you might want to install a guest operating system directly on a physical disk or partition even if you do not need to boot that disk on the host, outside of the virtual machine.

It is possible to use either an unused partition or a completely unused disk on the host as a disk in the virtual machine. However, it is important to be aware that an operating system installed in this setting probably cannot boot outside of the virtual machine, even though the data is available to the host. (For information about using an operating system that can also boot outside of the virtual machine, see the VMware technical note called *Dual-Boot Computers and Virtual Machines*.)

Physical disks are an advanced feature and should be configured only by expert users. To use a physical disk in a virtual machine, you can either use the virtual machine settings editor to add the physical disk, or you can create a new virtual machine and specify at creation time which physical disk the virtual machine should use.

Regardless of which strategy you use, make sure the physical disk meets the requirements listed in the next section.

Prerequisites for Using a Physical Disk

Before you run the New Virtual Machine wizard or use the virtual machine settings editor to add a physical (raw) disk, perform the following tasks:

- Because the virtual machine and guest operating system access a physical disk partition while the host continues to run its operating system, verify that the partition is not mounted by the host or in use by another virtual machine.

  Corruption is possible if you allow the virtual machine to modify a partition that is simultaneously mounted under the host's operating system.

- Check the guest operating system documentation regarding the type of partition on which the operating system can be installed. For example, on Windows Vista hosts, you cannot use the system partition, or the physical disk that contains it, in a virtual machine.

  DOS, Windows 95, and Windows 98 operating systems must be installed on the first primary partition, whereas other operating systems, such as Linux, can be installed on a primary or an extended partition on any part of the drive.

- Make sure the physical partition or disk does not have data you will need in the future. If it does, back up the data.

- (Windows only) If you use a Windows host's IDE disk in a physical disk configuration, make sure it is not configured as the slave on the secondary IDE channel if the master on that channel is a CD-ROM drive.

- (Windows only) If your host is running Windows 2000, Windows XP, or Windows Server 2003, do not use a dynamic disk as a physical disk inside a virtual machine. You can use the disk management tool to check the type of disk used and, if it is a dynamic disk, change it to a basic disk (which destroys all data), as follows:

  a Open the disk management tool by choosing **Start>Settings>Control Panel>Administrative Tools>Computer Management>Disk Management**.

  b Delete all logical volumes on the disk. This destroys all data on the disk.

  c Right-click the disk icon and select **Revert to Basic Disk**.

  d Create the partitions you want on the disk.

- (Windows only) Make sure the partition you want to use is unmapped in the host, as follows:

  - **Windows NT host:** Use the Disk Administrator (**Start>Programs>Administrative Tools**). Highlight the partition on which you plan to install the guest operating system, and choose **Tools>Assign Drive Letter**. In the dialog box, choose **Do not assign a drive letter for the partition** and click **OK**. The unmapping happens immediately.

  - **Windows Server 2003, Windows XP, or Windows 2000 host:** Use Disk Management (**Start>Settings>Control Panel>Administrative Tools>Computer Management>Storage>Disk Management**). Select the partition you want to unmap, and choose **Action>All Tasks>Change Drive Letter and Paths**. Click **Remove**.

  - **Windows Vista host:** Use Disk Management (**Start>Control Panel (Classic View)>Administrative Tools>Computer Management>Storage>Disk**

Management). Right-click the partition you want to unmap, and choose **Change Drive Letter and Paths**. Click **Remove**.

- (Linux only) Set the device group membership or device ownership, as follows:

  a Make sure the master physical disk device or devices are readable and writable by the user who runs VMware Workstation. On most distributions, the physical devices, such as `/dev/hda` (IDE physical disk) and `/dev/sdb` (SCSI physical disk) belong to group-id `disk`. If this is the case, you can add VMware Workstation users to the `disk` group.

  Another option is to change the owner of the device. Consider all the security issues involved in this option.

  b Grant VMware Workstation users access to all `/dev/hd[abcd]` physical devices that contain operating systems or boot managers.

  You can then rely on the physical disk configuration files in VMware Workstation to guard access. This provides boot managers access to configuration files and other files they might need to boot the operating systems. For example, LILO needs to read `/boot` on a Linux partition to boot a non-Linux operating system that might be on another drive.

After you are finished preparing the physical disk, use either of the following strategies to use the physical disk in a virtual machine:

- "Creating a New Virtual Machine That Uses a Physical Disk" on page 207
- "Using the Virtual Machine Settings Editor to Add a Physical Disk" on page 209

For general information about using physical disks with Workstation, see "Physical Disks" on page 198.

Creating a New Virtual Machine That Uses a Physical Disk

Use the New Virtual Machine wizard if you want to create a new virtual machine that uses a physical disk rather than simply add a physical disk to an existing virtual machine.

To create a virtual machine that uses a physical disk

1 Make sure you have completed the tasks described in "Prerequisites for Using a Physical Disk" on page 205.

2 Because the process is similar for creating any type of virtual machine, follow the instructions in "Setting Up a New Virtual Machine" on page 87, but be sure to use the following options when completing the wizard:

- When prompted to specify the type of virtual machine configuration, select **Custom**.
- On the Select a Disk page, select **Use a physical disk**, and specify whether you want to use individual partitions or the entire disk.

  If you use individual partitions, only the partitions you select will be accessible to the virtual machine. The other partitions might be "visible" to the guest operating system, but it is not possible to mount, access, or format them.

3 After you finish creating the virtual machine, if you want to specify a device node for your virtual disk, or if you want to exclude disks from snapshots, use the virtual machine settings editor, as follows:

   a Select the virtual machine, and choose **VM>Settings**.

     The virtual machine settings editor opens.

   b On the **Hardware** tab, select the physical disk and click **Advanced**.

   c If you want to exclude disks from snapshots, select **Independent** for the mode and choose one of the following options:

     - **Persistent** – Changes are immediately and permanently written to the disk.
     - **Nonpersistent** – Changes to the disk are discarded when you power off or revert to a snapshot.

     For more information on the snapshot feature, see "Using Snapshots" on page 225.

4 Install the guest operating system on the physical disk.

  Be sure to use the *VMware Guest Operating System Installation Guide*, which contains instructions specific to each type of supported operating system. This guide is available from the Workstation **Help** menu.

For more information about using physical disks, see "Physical Disks" on page 198.

Using the Virtual Machine Settings Editor to Add a Physical Disk

Use the virtual machine settings editor to add a new physical disk to your virtual machine, as described in the following procedure.

To add a physical disk to a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add** to start the Add Hardware wizard.

4 On the Hardware Type page, select **Hard Disk** and click **Next**.

5 On the Select a Disk page, select **Use a physical disk** and click **Next**.

6 When the warning appears, click **OK**.

7 Complete the Select a Physical Disk page and click **Next**.

- Choose the physical hard disk to use from the drop-down list. Workstation supports physical disks up to 2TB.
- Select whether you want to use the entire disk or only individual partitions on the disk. If you select **Use entire disk**, continue with step 9.

8 If the Select Partitions page appears, select the partitions you want to use in the virtual machine and click **Next**.

This page appears if you selected **Use individual partitions** in step 7.

Only the partitions you select will be accessible to the virtual machine. The other partitions might be "visible" to the guest operating system, but it is not possible to mount, access, or format them.

9 On the Specify Disk File page, accept the default filename and location or browse to a different location.

10 To specify a device node for your virtual disk, or to exclude disks from snapshots, click **Advanced**.

To exclude disks from snapshots, select **Independent** for the mode and choose one of the following options:

- **Persistent** – Changes are immediately and permanently written to the disk.
- **Nonpersistent** – Changes to the disk are discarded when you power off or revert to a snapshot.

For more information on the snapshot feature, see "Using Snapshots" on page 225.

11 Click **Finish**.

The wizard configures the new physical disk.

12 If the partitions used on the physical disk are not formatted for your guest operating system, use the guest operating system's tools to format them.

CAUTION Regarding the use of `fdisk` or a similar utility:

- After you add a virtual machine disk by using one or more partitions on a physical disk, never modify the partition tables by running `fdisk` or a similar utility in the guest operating system.
- If you use `fdisk` or a similar utility on the host operating system to modify the partition table of the physical disk, you must re-create the virtual machine's physical disk.

Adding DVD/CD-ROM and Floppy Drives to a Virtual Machine

Workstation 6 virtual machines can use up to 4 IDE devices and up to 60 SCSI devices. Any of these devices can be a virtual or physical hard disk or DVD or CD-ROM drive.

A virtual machine can read data from a DVD disc. Workstation does not support playing DVD movies in a virtual machine. (You might be able to play a movie if you use a DVD player application that does not require video overlay support in the video card.)

This section provides instructions for adding the following devices:

- "Adding DVD or CD Drives to a Virtual Machine" on page 211
- "Adding Floppy Drives to a Virtual Machine" on page 212
- "Connecting a CD-ROM/DVD or Floppy Drive to an Image File" on page 213

Adding DVD or CD Drives to a Virtual Machine

You can add one or more DVD or CD drives to your virtual machine. You can connect the virtual machine's drive to a physical drive on the host machine or to an ISO image file.

You can configure the virtual DVD or CD drive as either IDE or SCSI, no matter what kind of physical drive you connect it to. In other words, if your host computer has an IDE CD drive, you can set up the virtual machine's drive as either SCSI or IDE and connect it to the host's drive. The same is true if the host's physical drive is a SCSI drive.

To add a DVD or CD drive to a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add** to start the Add Hardware wizard.

4 On the Hardware Type page, select **DVD/CD-ROM Drive** and click **Next**.

5 Make a selection on the Select a Drive Connection page and click **Next**.

6 Do one of the following:

If you selected **Use physical drive**:

a Choose a drive from the drop-down list or choose **Auto detect**.

b If you do not want the CD drive connected when the virtual machine starts, deselect **Connect at power on**.

c To specify which device node the drive should use in the virtual machine, click **Advanced**.

Select **Legacy emulation** only if you have had problems using normal mode. For details, see "Legacy Emulation for DVD and CD Drives" on page 212.

d After you have made any desired changes in these settings, click **Finish**.

If you selected **Use ISO image**:

a Enter the path and filename for the image file or browse to the file.

b If you do not want the CD drive connected when the virtual machine starts, deselect **Connect at power on**.

c If you want to specify which device node the drive should use in the virtual machine, click **Advanced**.

d After you have made any desired changes in these settings, click **Finish**.

The drive is set up initially so it appears to the guest operating system as an IDE drive.

7 If you want the drive to appear to the guest operating system as a SCSI drive, click the drive's entry in the virtual machine settings editor and make that change in the settings panel on the right.

Legacy Emulation for DVD and CD Drives

In normal mode (that is, not legacy emulation mode), the guest operating system communicates directly with the CD or DVD drive. This direct communication enables you to read multisession CDs, perform digital audio extraction, view videos, and use CD and DVD writers to burn discs.

In contrast, legacy emulation mode enables you to read only from data discs in the DVD or CD drive. It does not provide the other capabilities of normal mode. Using legacy emulation mode is a way to work around problems that arise when a guest operating system has difficulty communicating directly with a DVD or CD drive.

Use the virtual machine settings editor (**VM>Settings**) to set the **Legacy emulation** option for DVD and CD drives attached to the virtual machine:

- On Windows hosts, this option is deselected by default.
- On Linux hosts with IDE drives, the default setting depends on whether the `ide-scsi` module is loaded in your kernel. The `ide-scsi` module must be loaded, or you must be using a physical SCSI drive, to connect directly to the DVD or CD drive.

If you run more than one virtual machine at a time, and if their CD drives are in legacy emulation mode, start the virtual machines with their CD drives disconnected. This ensures that you do not have multiple virtual machines connected to the CD drive at the same time.

Adding Floppy Drives to a Virtual Machine

You can add floppy drives to your virtual machine, to a total of two floppy drives. A virtual floppy drive can connect to a physical floppy drive on the host computer, to an existing floppy image file, or to a blank floppy image file.

To add a floppy drive to a virtual machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add** to start the Add Hardware wizard.

4 On the Hardware Type page, select **Floppy Drive** and click **Next**.

5 Complete the rest of the wizard by using the instructions provided in the wizard pages.

6 If you are adding a second floppy drive to the virtual machine, enable this second floppy drive in the virtual machine's BIOS, as follows:

a Boot the virtual machine, and as it boots, click inside the virtual machine window and press F2, to enter the BIOS setup utility.

b On the main screen, choose **Legacy Diskette B:** and use the plus (+) and minus (-) keys on the numerical keypad to select the type of floppy drive you want to use. Press F10 to save the settings.

Connecting a CD-ROM/DVD or Floppy Drive to an Image File

You can use the virtual machine settings editor (**VM>Settings**) to connect an existing virtual CD-ROM or floppy drive to an image file (ISO file), as described in the following procedure.

An ISO image file looks like a CD-ROM to your guest operating system and even appears as a CD-ROM in Windows Explorer.

To connect a CD-ROM or floppy drive to an image file

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Select the DVD/CD-ROM drive or floppy drive you want to connect to the image file.

4 Do one of the following:

- For a DVD or CD-ROM, select **Use ISO Image** and enter the path name and filename or browse to the file.
- For a floppy drive:
  - If the file already exists, select **Use floppy Image** and enter the path name and filename or browse to the file.
  - If you want to create a new image file, click **Create**. Browse to the directory where you want to store the floppy image file, supply a filename, and click **Save** (on Windows hosts) or **Open** (on Linux hosts).

  If you want to make the file read-only, select the **Read Only** check box.

5 Click **OK**.

Using VMware Virtual Disk Manager

VMware Virtual Disk Manager is a Workstation utility that allows you to create, manage, and modify virtual disk files from the command line or within scripts.

One key feature is the ability to enlarge a virtual disk so its maximum capacity is larger than it was when you created it. If you need more disk space in a given virtual machine, but do not want to add another virtual disk or use ghosting software to transfer the data on a virtual disk to a larger virtual disk, you can instead change the maximum size of the virtual disk. You cannot do this with physical hard drives.

NOTE To expand the size of a virtual disk, purchase additional software from another vendor so that you can make the changes required for your virtual machine to access the additional disk space.

Virtual Disk Manager can enlarge the disk but does not modify its contents, so the partition information stays the same. You need third-party software, such as Partition Magic, that can modify the partition information on the virtual disk to utilize the additional virtual disk space you created with Virtual Disk Manager.

Another feature allows you to change disk types. When you create a virtual machine, you specify how disk space is allocated. There are two options:

- All space for the virtual disk is allocated in advance. This corresponds to what the Virtual Disk Manager calls the preallocated disk type.
- Space allocated for the virtual disk begins small and grows as needed. This corresponds to what the Virtual Disk Manager calls the growable disk type.

With Virtual Disk Manager you can change whether the virtual disk type is preallocated or growable and whether the virtual disk is stored in a single file or split into 2GB files. For example, you might allocate all the disk space for a virtual disk, but later find that you need to reclaim some hard disk space on the host. You can convert the preallocated virtual disk into a growable disk, and then remove the original virtual disk file. The new virtual disk is large enough to contain all the data in the original virtual disk. The virtual disk grows as you add data to it.

These features and the ability to use scripting to automate management of virtual disks were added to Workstation in version 5.0.

You can use the Virtual Disk Manager to:

- Automate the management of virtual disks with scripts.
- Create virtual disks that are not associated with a particular virtual machine, for example, to be used as templates.
- Switch the virtual disk type from preallocated to growable, or from growable to preallocated. When you change the disk type to growable, you reclaim some disk space. You can shrink the virtual disk to reclaim even more disk space.
- Expand the size of a virtual disk so it is larger than the size specified when you created it.
- Defragment virtual disks.
- Prepare and shrink virtual disks without powering on the virtual machine (Windows hosts only).

You can use the Virtual Disk Manager with virtual disks created under VMware Server and VMware Workstation.

NOTE You cannot use the Virtual Disk Manager to create physical disks or shrink them.

Running the VMware Virtual Disk Manager Utility

To run the VMware Virtual Disk Manager utility, open a command prompt or terminal on the *host* operating system. On a Windows host, change to the directory where you installed your Workstation software. By default, this directory is:

```
C:\Program Files\VMware\VMware Workstation
```

The command syntax is:

```
vmware-vdiskmanager [options]
```

Table 9-1 lists the options you can use with `vmware-vdiskmanager`. For examples of how you use these options to perform various tasks, see "Examples Using the VMware Virtual Disk Manager" on page 218.

Table 9-1. VMware Virtual Disk Manager Utility Commands

Options and Parameters	Description
`<diskname>`	Name of the virtual disk file. The virtual disk file must have a `.vmdk` extension. Specify a path to the folder where you want to store the disk files. If you mapped a network share on your host operating system, you can create the virtual disk on that share by providing the correct path information with the disk filename.
`-c`	Creates the virtual disk. Use the `-a`, `-s`, and `-t` options, and specify the name of the virtual disk (`<diskname>`).
`-r <sourcediskname>`	Converts the specified virtual disk, creating a new virtual disk as a result. Use the `-t` option to specify the disk type to which the virtual disk is converted, and specify the name of the target virtual disk (`<targetdiskname>`). After the conversion is completed and you have tested the converted virtual disk to make sure it works as expected, delete the original virtual disk file. For the virtual machine to recognize the converted virtual disk, use the virtual machine settings editor to remove the existing virtual disk from the virtual machine, and then add the converted disk to the virtual machine. See "Adding Virtual and Physical Disks to a Virtual Machine" on page 202.
`-x <n>[GB|MB] <diskname>`	Expands the virtual disk to the specified capacity. Specify the new, larger size of the virtual disk in gigabytes or megabytes. You cannot change the size of a physical disk. **Caution:** Before running the Virtual Disk Manager utility, back up your virtual disk files.
`-d <diskname>`	Defragments the specified virtual disk. You can defragment only growable virtual disks. You cannot defragment preallocated virtual disks.
`-p <mountpoint>`	(Windows only) Prepares a virtual disk for shrinking. For more information, see "Shrinking Virtual Disks with Virtual Disk Manager (Windows Only)" on page 217.
`-k <diskname>`	(Windows only) Shrinks the specified virtual disk. For more information, see "Shrinking Virtual Disks with Virtual Disk Manager (Windows Only)" on page 217.
`-a [ide|buslogic|lsilogic]`	Specifies the disk adapter type. Specify an adapter type when creating a new virtual disk. Choose one of the following types: ■ `ide` – For an IDE adapter. ■ `buslogic` – For a BusLogic SCSI adapter. ■ `lsilogic` – For an LSI Logic SCSI adapter.

Table 9-1. VMware Virtual Disk Manager Utility Commands (Continued)

Options and Parameters	Description
`-s <n>[GB|MB]`	Specifies the size of the virtual disk. Specify whether the size `<n>` is in gigabytes or megabytes. Specify the size of a virtual disk when you create it. Even though you must specify the size of a virtual disk when you expand it, do not use the `-s` option.
`-t [0|1|2|3]`	Specify the type of virtual disk when you create a new one or reconfigure an existing one. Specify one of the following disk types: `0` – To create a growable virtual disk contained in a single virtual disk file. `1` – To create a growable virtual disk split into 2GB files. `2` – To create a preallocated virtual disk contained in a single virtual disk file. `3` – To create a preallocated virtual disk split into 2GB files.
`-q`	Disables Virtual Disk Manager logging. If you keep logging enabled, messages generated by the Virtual Disk Manager are stored in a log file. The name and location of the log file appear in the command prompt or terminal window after the Virtual Disk Manager command is run.

Shrinking Virtual Disks with Virtual Disk Manager (Windows Only)

On a Windows host, you can use the Virtual Disk Manager to prepare and shrink growable virtual disks (not physical disks) without powering on the virtual machine. Shrinking a virtual disk does not reduce the maximum capacity of the virtual disk itself. For more information, see "Shrinking Virtual Disks" on page 200.

CAUTION You cannot shrink a virtual disk if the virtual machine has snapshots. To keep the virtual disk in its current state, use the snapshot manager to delete all snapshots. To discard changes made since you took a snapshot, revert to the snapshot.

To shrink a virtual disk

1 Mount each volume of the virtual disk.

If the virtual disk is partitioned into volumes, each volume of the virtual disk (drive C: or D:, for example) must be must be mounted and prepared separately.

To mount a volume, see "Using a Mapped Drive (Windows Only)" on page 178. Or use the VMware DiskMount Utility, available as a free download from the VMware Web site. Go to www.vmware.com/download/diskmount.html. The VMware DiskMount user's manual is available from the VMware Web site at

www.vmware.com/pdf/VMwareDiskMount.pdf. It contains instructions on mounting and unmounting virtual disk volumes with DiskMount.

2 Use the Virtual Disk Manager to prepare the volume for shrinking, as described in the example in "Preparing a Virtual Disk for Shrinking" on page 219.

3 Disconnect (unmount) the volume, either by using the procedure described in "Using a Mapped Drive (Windows Only)" on page 178 or by using VMware DiskMount.

4 Repeat the mounting, preparing, and unmounting process for each volume of the virtual disk.

5 Use the Virtual Disk Manager to shrink the virtual disk, as described in the example in "Shrinking a Virtual Disk" on page 220.

Examples Using the VMware Virtual Disk Manager

The following examples illustrate how to use the command-line version of:

- "Creating a Virtual Disk" on page 218
- "Converting a Virtual Disk" on page 218
- "Increasing the Size of an Existing Virtual Disk" on page 219
- "Renaming a Virtual Disk" on page 219
- "Defragmenting a Virtual Disk" on page 219
- "Preparing a Virtual Disk for Shrinking" on page 219
- "Shrinking a Virtual Disk" on page 220

Creating a Virtual Disk

To create a new virtual disk, use a command like the following:

```
vmware-vdiskmanager -c -t 0 -s 40GB -a ide myDisk.vmdk
```

This creates a 40GB IDE virtual disk named `myDisk.vmdk`. The virtual disk is contained in a single `.vmdk` file. The disk space is not preallocated.

Converting a Virtual Disk

To convert the virtual disk type from preallocated to growable, use a command like the following:

```
vmware-vdiskmanager -r sourceDisk.vmdk -t 0 targetDisk.vmdk
```

This converts the disk from its original preallocated type to a growable virtual disk that consists of a single virtual disk file. The virtual disk space is no longer preallocated, and

the Virtual Disk Manager reclaims some disk space in the virtual disk so it is only as large as the data contained within it.

Increasing the Size of an Existing Virtual Disk

To expand a virtual disk, use a command like the following:

```
vmware-vdiskmanager -x 40GB myDisk.vmdk
```

This increases the maximum capacity of the virtual disk to 40GB.

Renaming a Virtual Disk

To rename a virtual disk, first remove it from any virtual machine that contains the disk (choose **VM>Settings><virtual_disk>**, and click **Remove**). Next, use a command like one of the following (the file paths assume a Windows host):

- To rename the disk and keep it in the same location, use:
  ```
  vmware-vdiskmanager -n myDisk.vmdk myNewDisk.vmdk
  ```
- To rename the disk and locate it in a different directory, use:
  ```
  vmware-vdiskmanager -n myDisk.vmdk ..\<new-path>\myNewDisk.vmdk
  ```
- To locate the disk in a different directory and keep the same name, use:
  ```
  vmware-vdiskmanager -n myDisk.vmdk ..\<new-path>\myDisk.vmdk
  ```

After you rename or relocate the virtual disk, add it back to any virtual machines that use it. For instructions, see "Adding an Existing Virtual Disk to a Virtual Machine" on page 204.

Defragmenting a Virtual Disk

To defragment a virtual disk, use a command like the following:

```
vmware-vdiskmanager -d myDisk.vmdk
```

You cannot defragment a virtual disk if you allocated all the disk space when you created the virtual disk. You cannot use this command to defragment a physical disk.

See "Defragmenting Disk Drives" on page 382 for a discussion of the performance impact of defragmenting drives.

Preparing a Virtual Disk for Shrinking

Before you can shrink a virtual disk, you must prepare each volume on the disk (C: or D:, for example) for shrinking. The following example assumes that the volume is mounted as the M: drive. (Information about mounting volumes appears in the

procedure "To shrink a virtual disk" on page 217.) To prepare a volume of the virtual disk for shrinking, use the following command:

```
vmware-vdiskmanager -p M:
```

After the preparations are complete, unmount the volume. Repeat this process for each volume of the virtual disk. After you prepare all the volumes for shrinking, you can shrink the virtual disk.

Shrinking a Virtual Disk

To shrink a virtual disk, it must be located on a Windows host. Before you can shrink the virtual disk, prepare all the volumes of the virtual disk for shrinking. Then use a command like the following:

```
vmware-vdiskmanager -k myDisk.vmdk
```

You cannot shrink a virtual disk if you allocated all the disk space when you created the virtual disk. You cannot shrink a physical disk.

If the virtual disk has any snapshots, you cannot shrink the virtual disk. Delete all snapshots before you shrink the virtual disk.

Using Dual-Boot Computers with Virtual Machines

Many users install Workstation on a dual-boot or multiple-boot computer so they can run one or more of the existing operating systems in a virtual machine. For more information about using dual-boot computers with Workstation, see the VMware technical note called *Dual-Boot Computers and Virtual Machines.*

Legacy Virtual Disks

This section discusses your options for using Workstation 6 in a mixed environment with virtual machines that were created with earlier versions of Workstation or created with other VMware products.

Following is a brief summary of feature compatibility between various virtual hardware versions of VMware Workstation:

- A Workstation 6 virtual machine supports all Workstation 6 features but is not compatible with other VMware products.
- A Workstation 5 virtual machine is compatible with VMware Server 1.x, ESX Server 3.x, and VMware Player 1.x.

  Workstation versions 5.5 and later support 64-bit guest operating systems.
- A Workstation 4 virtual machine is compatible with VMware GSX Server 3.x, ESX Server 2.x, and ACE 1.0.

You can use Workstation 6 to power on virtual machines created with any of the product versions in this list. However, many new features of Workstation are not available in older virtual machines. To upgrade your virtual machines to version 6, see "Changing the Version of the Virtual Machine" on page 59.

If you decide not to upgrade a virtual machine to Workstation 6, VMware recommends that you upgrade VMware Tools to the latest version. Follow the instructions for your guest operating system in "Installing and Upgrading VMware Tools" on page 113. Do not remove the older version of VMware Tools before installing the new version.

You can also use Workstation 6 to create a version 4 or 5 virtual machines. For instructions, see "Setting Up a New Virtual Machine" on page 87.

For more information about compatibility between VMware products, refer to the *VMware Virtual Machine Mobility Planning Guide*.

NOTE If you have Workstation 2 or 3 virtual machines that you want to use with Workstation 6, upgrade the virtual machines to at least Workstation version 4 before you attempt to power them on with Workstation 6.

Preserving the State of a Virtual Machine

10

Workstation provides two ways to preserve the state of a virtual machine: you can suspend the virtual machine or take a snapshot of it. This chapter describes the suspend and snapshot features and helps you understand when to use them.

Because the experimental record/replay feature uses elements from the snapshot manager, instructions for recording and replaying virtual machine activity are also included.

This chapter includes the following topics:

- "Using the Suspend and Resume Features" on page 223
- "Using Snapshots" on page 225
- "Recording Activity of a Virtual Machine (Experimental)" on page 237

Using the Suspend and Resume Features

The suspend and resume feature is useful when you want to save the current state of your virtual machine, and continue work later from the same state. When you resume, any applications you were running at the time you suspended the virtual machine are resumed in their running state, and the content is the same as it was when you suspended the virtual machine.

When you resume and do additional work in the virtual machine, you cannot return to the state the virtual machine was in at the time you suspended. To preserve the state of the virtual machine so you can return to the same state repeatedly, take a snapshot, as described in "Using Snapshots" on page 225.

The speed of the suspend and resume operations depends on how much data has changed during the time that the virtual machine was running. In general, the first suspend operation takes longer than later suspend operations.

When you suspend a virtual machine, a file with a `.vmss` extension is created. This file contains the entire state of the virtual machine. When you resume the virtual machine, its state is restored from the `.vmss` file.

To prepare a virtual machine for using suspend and resume

1 Make sure VMware Tools is installed in the guest operating system.

For instructions, see "Installing and Upgrading VMware Tools" on page 113.

2 Configure the **Suspend** button to do either a "hard" suspend or a "soft" suspend operation, as follows:

a Select the virtual machine and choose **VM>Settings** from the Workstation menu bar.

The virtual machine settings editor opens.

b Click the **Options** tab, and select **Power**.

c In the **Power controls** section, specify whether you want to use a hard suspend operation (**Suspend**) or a soft suspend (**Suspend Guest**).

If you select **Suspend Guest**, a script runs that either releases the IP address (on Windows guests using DHCP) or stops networking for the virtual machine (on Linux, FreeBSD, and Solaris guests).

d Click **OK** to close the virtual machine settings editor.

To suspend a virtual machine

1 If your virtual machine is running in full screen mode, return to windowed mode by pressing the Ctrl+Alt+Enter key combination.

2 Click the **Suspend** button on the Workstation toolbar.

To resume a virtual machine that you have suspended

1 Start Workstation and choose a virtual machine you have suspended.

2 Click **Resume** on the Workstation toolbar.

Using Snapshots

Workstation snapshots allow you to preserve the state of the virtual machine so you can return to the same state repeatedly. For example, you might use snapshots to develop training courses. You can take a snapshot of the machine for each lesson or lab in the course. Similarly, if you test software, you can take a snapshot before installing different versions of a program to ensure each installation begins from an identical baseline.

Snapshot Processes: Linear Versus Process Tree

Taking a snapshot saves the current state of the virtual machine, so you can return to it at any time. Snapshots are useful when you need to revert a virtual machine repeatedly to the same state, but you don't want to create multiple virtual machines.

To save the current state of your virtual machine temporarily, see "Using the Suspend and Resume Features" on page 223.

You can take multiple snapshots of a virtual machine, to save any state you want to return to. To take snapshots of multiple virtual machines, you must take a separate snapshot for each virtual machine. You might want to do this, for example, if you need to take snapshots for all virtual machines in a team.

NOTE Workstation operates more efficiently with snapshots disabled. If you do not need snapshot functionality, disable it for better performance. See "Disabling Snapshots" on page 235.

Snapshots in a Linear Process

One common use of snapshots is in a development process, as a way to save each step in a linear process. That way, as you add new, untested code to a project, you can always revert to a prior known working state of the project when newly added code does not work as expected.

Another example of using snapshots in a linear process is a computerized training course. You can take snapshots of each lesson starting point, so you can instantly revert to the appropriate place for each student, skipping lengthy computer preparation time.

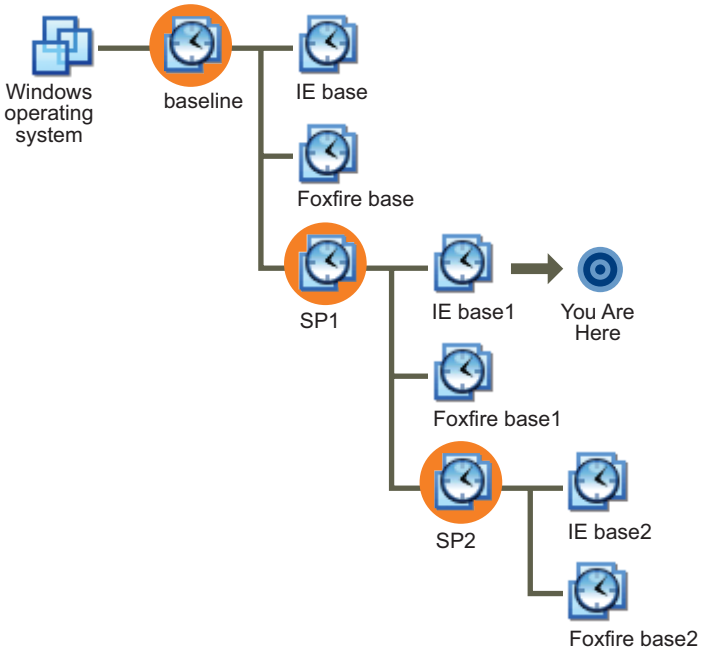
Figure 10-1. Snapshots as Restore Points in a Linear Process

Workstation supports more than 100 snapshots per linear process.

Snapshots in a Process Tree

Another way to use snapshots is shown in the Figure 10-2. Here, instead of saving each step of a process in a single long sequence, you save a number of sequences, as branches from a single baseline. This strategy is often used in testing software. You can take a snapshot before installing different versions of a program to ensure that each different installation begins from an identical baseline.

Figure 10-2. Snapshots as Restore Points in a Process Tree



Workstation supports more than 100 snapshots per branch in a process tree.

Relationship Between Snapshots

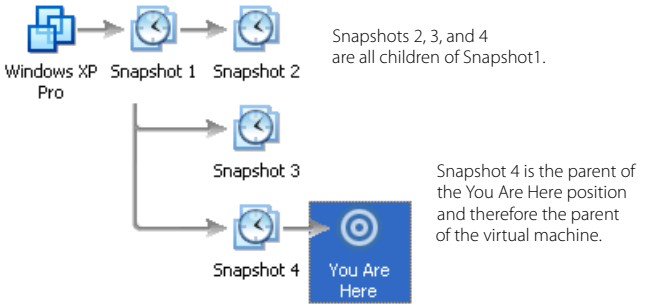
The relationship between snapshots is like parent to child:

- In a linear process, each snapshot has one parent and one child, except for the last snapshot, which has no children.
- In a process tree, each snapshot has one parent, but one snapshot can have more than one child. Many snapshots have no children.

The parent snapshot of a virtual machine is the snapshot on which the current state (the You Are Here position in Figure 10-3) is based. After you take a snapshot, that stored

state is the parent snapshot of the virtual machine. If you revert or go to an earlier snapshot, the earlier snapshot becomes the parent snapshot of the virtual machine.

Figure 10-3. Parent-Child Relationship Between Snapshots


Windows XP Pro
Snapshot 1
Snapshot 2
Snapshots 2, 3, and 4 are all children of Snapshot1.
Snapshot 3
Snapshot 4
You Are Here
Snapshot 4 is the parent of the You Are Here position and therefore the parent of the virtual machine.

What to Use Snapshots For

The topics in this section describe strategies for using snapshots.

Use Snapshots as Protection from Risky Changes

If you plan to make risky changes in a virtual machine (for example, testing new software or examining a virus), take a snapshot before you begin. If you encounter a problem, you can restore the virtual machine to the state preserved in that snapshot.

If your risky actions cause no problems you can take another snapshot of the virtual machine in its new state. Snapshots can minimize lost work if something goes wrong. With multiple snapshots of saved positions, you can return at any time to any important position when you discover a problem.

Start a Virtual Machine Repeatedly in the Same State

You can configure the virtual machine to revert to a snapshot any time it is powered off. You might use this feature, for example, when setting up student virtual machines to power on for each new class at the beginning of the lesson, discarding the previous student's work. See "Reverting at Power Off" on page 235 for the procedure.

Automatically Record Milestone Status

You can configure a virtual machine to take a snapshot any time it is powered off, preserving a virtual audit trail as work progresses. See "Snapshot Options When You Power Off a Virtual Machine" on page 236 for configuring automatic snapshots at power off.

What Is Captured by a Snapshot

A snapshot captures the entire state of the virtual machine at the time you take the snapshot. This includes:

- **Memory state** – Contents of the virtual machine's memory.
- **Settings state** – Virtual machine settings.
- **Disk state** – State of all the virtual machine's virtual disks.

Snapshots operate on individual virtual machines. If you select a team of virtual machines and take a snapshot, only the active virtual machine's state is preserved. See "Viewing Teams and Their Virtual Machines" on page 258.

When you revert to a snapshot, you return the virtual machine's memory, settings, and virtual disks to the state they were in when you took the snapshot. If you want the virtual machine to be suspended, powered on, or powered off when you launch it, be sure it is in the state you want when you take the snapshot.

NOTE The state of a physical disk or independent disk is not preserved when you take a snapshot.

When to Take Snapshots

This section lists some limitations regarding snapshots.

Activities That Conflict with Snapshots

When you take a snapshot, be aware of other activity going on in the virtual machine and the likely impact of reverting to that snapshot. In general, it is best to take a snapshot when no applications in the virtual machine are communicating with other computers. The potential for problems is greatest if the virtual machine is communicating with another computer, especially in a production environment.

Consider a case in which you take a snapshot while the virtual machine is downloading a file from a server on the network. After you take the snapshot, the virtual machine continues downloading the file, communicating its progress to the server. If you revert to the snapshot, communications between the virtual machine and the server are confused and the file transfer fails.

Or consider a case in which you take a snapshot while an application in the virtual machine is sending a transaction to a database on a separate machine. If you revert to that snapshot after the transaction starts but before it has been committed, the database is likely to be confused.

Considerations for Workstation 4 Virtual Machines

For virtual machines that were created with Workstation 4 and that have multiple disks in different modes, the following exceptions apply:

- **Snapshots and older virtual machines** – You must upgrade a Workstation 4 virtual machine before taking a snapshot. See "Changing the Version of the Virtual Machine" on page 59. For more information about using Workstation 6 with virtual machines and snapshots created under Workstation version 4 see "Snapshots and Workstation 4 Virtual Machines" on page 237.
- **Snapshots and multiple disks in different modes** – You must power off the virtual machine before taking a snapshot if the virtual machine has multiple disks in different disk modes. For example, if you have a special purpose configuration that requires you to use an independent disk, you must power off the virtual machine before taking a snapshot.

Enabling Snapshot Actions as a Background Activity

Taking a snapshot is not instantaneous. By default, a preference setting enables you to take snapshots as a background process. This way, you can continue working while Workstation preserves the snapshot in the background.

If you take another snapshot or revert to one before Workstation completes a pending snapshot operation, a progress dialog box appears. When this occurs, you must wait for the pending snapshot operation to finish before the next snapshot or resume operation begins.

Enabling background snapshots for a host with slow hard disks can adversely affect performance. If you experience significant performance problems when taking or restoring snapshots, turn off this option, as described in the following procedure.

To enable or disable background snapshots

1 From the Workstation menu bar, choose **Edit>Preferences**.

2 Click the **Priority** tab, and do one of the following:

- To enable background snapshots, make sure the check box in the **Snapshots** area is selected.
- To disable background snapshots, deselect the check box.

3 Click **OK**, and restart the virtual machine.

Excluding Virtual Disks from Snapshots

In certain configurations, you might want to revert some disks to a snapshot while other disks retain all changes. For example, you might want a snapshot to preserve a disk with your operating system and applications, while always keeping the changes to a disk with your documents.

You can exclude virtual disks from a snapshot by changing the disk mode. Before you attempt to change the disk mode, power off the virtual machine and delete any existing snapshots.

To exclude a virtual disk from all snapshots

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, select the drive you want to exclude and click **Advanced**.

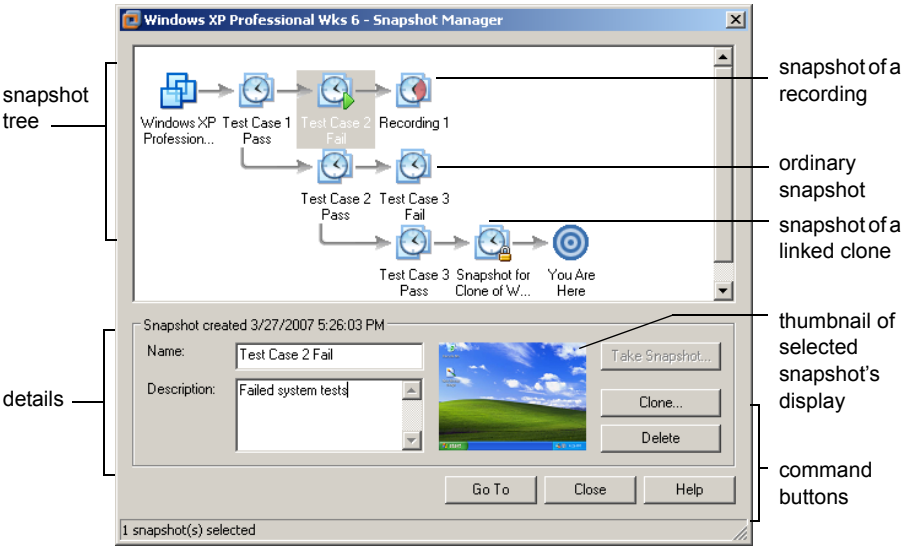
4 In the Advanced dialog box, select **Independent** and select one of the following options:

- **Persistent** – Changes are immediately and permanently written to the disk. All changes to an independent disk in persistent mode remain, even when you revert to a snapshot.
- **Nonpersistent** – Current changes to the disk are discarded when you power off or revert to a snapshot.

Working with Snapshots in the Snapshot Manager

In the snapshot manager, you can review all snapshots for the active virtual machine and act on them directly. Figure 10-4 illustrates the components of the snapshot manager.

Figure 10-4. Snapshot Manager: Windows Host

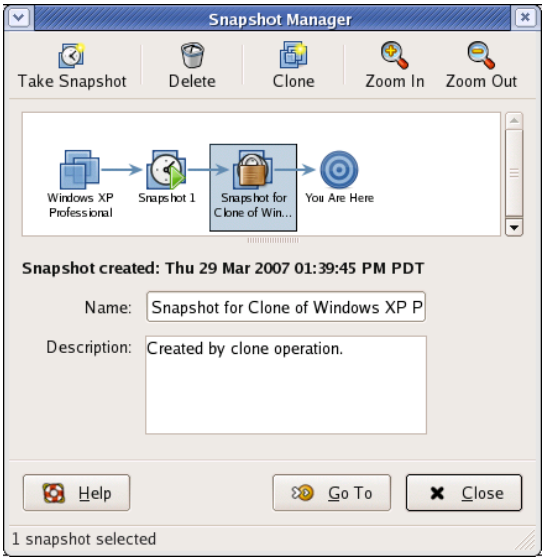


The snapshot tree shows all snapshots for the virtual machine, arranged to show the relationship between snapshots. The **You Are Here** icon is not a snapshot; it shows the current state of the virtual machine. See "Relationship Between Snapshots" on page 226.

NOTE Move the mouse pointer over a snapshot (without clicking) to display the complete name of that snapshot. This is useful when a long name is truncated in the snapshot tree display.

The snapshot manager has a slightly different appearance on Linux hosts, as shown in Figure 10-5.

Figure 10-5. Snapshot Manager: Linux Host



On Linux hosts, right-click the toolbar at the top of the window to change the icon style. You can display icons and text, icons only, text only, and so on.

Following is a description of the snapshot actions you can perform by using the snapshot manager:

- **Take Snapshot** – With the **You Are Here** icon selected, takes a snapshot. You can take a snapshot while a virtual machine is powered on, powered off, or suspended. For more information, see "Taking a Snapshot" on page 233.
- **Go To/Replay** – The button is labeled **Go To** if you select a snapshot. It is labeled **Replay** if you select a recording:
  - **Go To** restores the virtual machine to the state it was in when the selected snapshot was taken. Double-clicking a snapshot is the same as selecting that snapshot and clicking **Go To**.
  - **Replay** places the virtual machine in the state it was in when the recording was begun. The virtual machine then goes through the same activities it did throughout the time the recording was made. Double-clicking a recording is the same as selecting it and clicking **Replay**. For more information about this feature, see "Recording Activity of a Virtual Machine (Experimental)" on page 237.

- **Clone** – Creates a standalone virtual machine called a clone. Power off the virtual machine before making a clone from a snapshot. For more about clones, see "Cloning a Virtual Machine" on page 245.

CAUTION If a snapshot has been cloned, it becomes locked. If you delete a locked snapshot, the clones created from that snapshot no longer operate.

- **Delete** – Deletes the selected snapshots or recordings. To delete a snapshot or recording and all its children, right-click it and choose **Delete Snapshot/Recording and Children**. Deleting a snapshot or recording does not affect other snapshots or recordings or the current state of the virtual machine.

  To select all snapshots and recordings, right-click a snapshot or recording and choose **Select All**.

  NOTE You cannot delete the snapshot if the associated virtual machine is designated as a template for cloning. See "Linked Clones and Access to the Parent Virtual Machine" on page 250 for a description of template settings for linked clones.

To use the snapshot manager

1 Open the snapshot manager by doing one of the following:

   - From the Workstation menu bar, choose **VM>Snapshot>Snapshot Manager**.
   - On the Workstation toolbar, click the **Manage Snapshots for Virtual Machine** icon.

2 Do one of the following:

   - Select a snapshot or recording and click the button for the desired action. To select more than one, Ctrl+click the desired snapshots and recordings.
   - Right-click a snapshot or recording and choose the desired action from the context menu that appears.

   These actions were described in the text preceding this procedure.

Taking a Snapshot

You can take a snapshot while a virtual machine is powered on, powered off, or suspended. If you are suspending a virtual machine, wait until the suspend operation has finished before taking a snapshot. As described in "Activities That Conflict with Snapshots" on page 228, do not take a snapshot when the virtual machine is communicating with another computer.

NOTE If your use of virtual machines is strongly performance oriented, consider defragmenting the guest operating system's drives before taking a snapshot. Use the tools in the guest operating system to run a defragmentation utility.

For more information, see "Performance Impact of Defragmenting Snapshots and Linked Clones" on page 383.

To take a snapshot

1 Do one of the following:

- In the Workstation toolbar, click the **Take Snapshot of Virtual Machine** icon.
- From the Workstation menu bar, choose **VM>Snapshot>Take Snapshot**.
- From within the snapshot manager, with the **You Are Here** icon selected, click **Take Snapshot**. (To open the snapshot manager, choose **VM>Snapshot>Snapshot Manager**.)

2 Enter a unique name and description for your snapshot.

A description is not required but is useful for recording your notes about the virtual machine state captured in the snapshot. You can change the name and description at any time.

3 Click **OK**.

Restoring a Snapshot

You can restore a snapshot in Workstation by using the **Revert** and **Go to** commands. The following sections explain how these commands work.

Revert to Snapshot

Revert is a shortcut for *Go to the parent snapshot of the virtual machine*. That is, go to the parent snapshot of the You Are Here position. See "Relationship Between Snapshots" on page 226. Revert immediately activates the parent snapshot of the current state of the virtual machine. The current disk and memory states are discarded, and the virtual machine reverts to the disk and memory states of the parent snapshot.

To revert to the parent snapshot, from the Workstation menu bar, choose **VM>Snapshot>Revert to Snapshot**, or click the **Revert** button on the Workstation toolbar.

Go to Snapshot

This command activates the specified snapshot. Unlike **Revert**, the **Go to** command is not limited to the parent snapshot of the current state. You can choose any snapshot.

To go to a snapshot, from the Workstation menu bar, choose **VM>Snapshot** and select the snapshot by name. Or, in the snapshot manager, select a snapshot and click **Go To**. (To open the snapshot manager, choose **VM>Snapshot>Snapshot Manager**.)

Reverting at Power Off

This setting causes the virtual machine to revert to the parent snapshot any time it is powered off. The parent snapshot of a virtual machine is the snapshot on which the current state (the You Are Here position) is based. See "Relationship Between Snapshots" on page 226.

To set a virtual machine to revert to a snapshot at power off

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Snapshot/Replay**.

4 In the section **When powering off**, select **Revert to snapshot**.

You can also set the virtual machine to take a snapshot when you power off. For this and other power-off options, see "Snapshot Options When You Power Off a Virtual Machine" on page 236.

Disabling Snapshots

Workstation speed and response times are improved when snapshots are disabled, but without a snapshot, all changes made to a virtual machine are permanent and you cannot restore an earlier state.

Also, if you disable snapshots, you will not be able to use the experimental record/replay feature. For more information, see "Recording Activity of a Virtual Machine (Experimental)" on page 237.

If you want to disable snapshots, make sure that the virtual machine does not currently have any snapshots. If it has snapshots, delete them, as described in "Working with Snapshots in the Snapshot Manager" on page 231. You can then perform the following procedure.

To disable snapshots

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Snapshot/Replay**.

4 In the **General** section select **Disable Snapshots** and click **OK**.

If this check box is unavailable, it means that snapshots have already been created and need to be deleted, as described in "Working with Snapshots in the Snapshot Manager" on page 231.

Snapshot Options When You Power Off a Virtual Machine

You can set a virtual machine to automatically revert to a snapshot, or to take a new snapshot, whenever you power off the virtual machine.

Options when powering off include:

- **Just power off** – Powers off without making any changes to snapshots.
- **Revert to snapshot** – Reverts to the parent snapshot of the virtual machine's current state (that is, the parent snapshot of the You Are Here position in the Snapshot Manager window) so the virtual machine always starts in the state it was in when the parent snapshot was taken.

  Reverting to the snapshot discards changes. For example, an instructor might need to discard student answers for a computer lesson when a virtual machine is powered off at the end of class.
- **Take a new snapshot** – Takes a new snapshot of the virtual machine state after it is powered off. This is useful to preserve milestones automatically. The snapshot appears in the snapshot manager. The name of this snapshot is the date and time the virtual machine was powered off. The description is "Automatic snapshot created when powering off."
- **Ask me** – Prompts you, every time you power off a virtual machine, to specify whether you want to power off, revert, or take a snapshot.

To set a snapshot option that occurs when powering off

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Snapshot/Replay**.

4 Select an option in the section **When powering off**.

These options are described at the beginning of this topic and in the online help.

5 Click **OK**.

Snapshots and Workstation 4 Virtual Machines

Workstation 4 virtual machines do not support multiple snapshots. For full Workstation 6 functionality, you must upgrade.

If you want to upgrade but the Workstation 4 virtual machine has snapshots, you must first remove the snapshots. Use your earlier, Workstation 4.x application to remove the snapshot, and then upgrade to Workstation 6. You can then upgrade the virtual machine, as described in "Changing the Version of the Virtual Machine" on page 59.

If you choose not to upgrade, you preserve the ability to use the virtual machine in Workstation 4, but no multiple-snapshot functionality is allowed.

Recording Activity of a Virtual Machine (Experimental)

This experimental feature should be of interest to software developers and QA engineers. The record/replay feature lets you record all of a Workstation 5 or Workstation 6 virtual machine's activity over a period of time. Unlike Workstation's movie-capture feature, the record/replay feature lets you exactly duplicate the operations and state of the virtual machine throughout the time of the recording.

WARNING Features with experimental support are not intended to be enabled on production systems. Enabling the record/replay feature might cause the host to crash, causing you to lose data.

After you enable the record/replay feature for a virtual machine, start recording by simply clicking the **Record** button. Click the **Stop** button to end the recording and "go live." You can make multiple recordings and use the snapshot manager to name them,

delete them, and play them. You can also make an execution trace file of a recording to record events that occur during the recording.

Playing a recording is in some respects similar to going to a snapshot. When you play a recording, you discard the current state of the virtual machine and go to the recording. At any time when the recording is playing, you can click the **Stop** button and resume interacting with the guest operating system at the state the virtual machine is in when you click **Stop**.

The sections that follow provide details about how to enable this feature and use it:

- "Hardware and Virtual Hardware Requirements" on page 238
- "Recording and Playing Back Virtual Machine Activity" on page 240

Hardware and Virtual Hardware Requirements

Following is a list of requirements for and limitations of this feature:

- Host CPUs – For optimum performance, use a computer with an Intel P4 processor when using this feature. Other processors might operate more slowly during recording and replaying.

  If you use the record/replay feature on a host computer that does not have an Intel P4 processor, when you enable the record/replay feature and power on the virtual machine, a message appears, informing you that hardware acceleration will be disabled.

- Virtual machine version – Only Workstation 5 and 6 virtual machines can be recorded.

- Supported operating systems – You can use the record/replay feature only on 32-bit versions of the following guest operating systems:

  - Windows 2000
  - Windows XP
  - Windows 2003
  - Windows Vista
  - Red Hat Enterprise Linux 3 and 4
  - SUSE Linux 9.3 and 10.x

  SMP operating systems are *not* supported. If you attempt to enable the record/replay feature on an unsupported operating system, the virtual machine will not power on until you disable record/replay.

- Unsupported virtual devices – Before you enable the record/replay feature, use the virtual machine settings editor to remove the following devices from the virtual machine:
  - Floppy drives
  - CD-ROM drives

  NOTE Before you remove the CD-ROM drive from a virtual machine, make sure that VMware Tools is installed in the guest operating system. During VMware Tools installation, Workstation temporarily connects the virtual machine's first virtual CD-ROM drive to the correct ISO image file for the guest operating system.

  - USB controllers
  - Sound adapters
  - Generic SCSI devices
  - LSI Logic adapters

  In addition, avoid connecting the virtual machine to a network or disconnecting it during a recording session.
- Disk space – How much disk space a recording uses depends on the type of activity that occurs on the virtual machine during the recording session. Assume that you will need a substantial amount of disk space.
- Disk mode – You cannot use the record/replay feature if the virtual machine's virtual hard disk is set to independent mode. This is because recording virtual machine activity requires writing data about the disk to a "continual snapshot." To change the disk mode, use the virtual machine settings editor (**VM>Settings>Hardware>Hard Disk>Advanced**).

Recording and Playing Back Virtual Machine Activity

This section provides instructions for enabling the record/replay feature, making a recording, making an execution trace file of the recording, playing back the recording, and managing recordings.

NOTE Before you enable this feature, make sure that VMware Tools is installed in the guest operating system. Installing VMware Tools requires having a virtual CD-ROM drive in the virtual machine.

This section includes the following procedures:

- "To enable record/replay for a virtual machine" on page 240
- "To display the Replay toolbar" on page 241
- "To play back a recording" on page 242
- "To adjust the speed of playback" on page 243
- "To create an execution trace file of a recording" on page 244
- "To delete a recording" on page 244

To enable record/replay for a virtual machine

1 Make sure that the virtual machine meets the requirements listed in "Hardware and Virtual Hardware Requirements" on page 238.

2 Make sure the virtual machine is powered off.

3 Select the virtual machine and choose **VM>Settings**.

The virtual machine settings editor appears.

4 Click the **Options** tab, and select **Snapshot/Replay**.

5 On the **Snapshot/Replay** settings panel, use the following settings:

- Make sure the **Disable snapshots** check box is deselected.
- Select the **Enable execution record and replay** check box.

6 Click **OK**.

NOTE When you enable the record/replay feature, the debugging mode automatically gets set to **Full**. If you later disable record/replay, you need to manually set debugging mode back to **Normal**. See "Turning Off Debugging Mode" on page 378.

To display the Replay toolbar

Choose **View>Toolbars>Replay**.

The **Replay** toolbar appears to the right of the other toolbars you have displayed. It contains the following buttons:

- **Replay Last Recording** – Plays the last recording you made for the selected virtual machine. If the virtual machine is powered off, it is resumed, as if it had been suspended.

  To play an earlier recording, use the snapshot manager. Choose **VM>Snapshot>Snapshot Manager**.

- **Record** – Takes a snapshot of the virtual machine and begins recording.
- **Stop** – Stops the recording or replay that is in progress.

To make a recording

1 Power on the virtual machine.

2 When you want to begin recording, click the **Record** button in the toolbar, or choose **VM>Replay>Record**.

  A snapshot is taken, and an icon appears in the status bar to indicate that recording is in progress.

  If the **Record** command is unavailable, the feature might not be enabled or the hard disk might be set to independent mode. See "To enable record/replay for a virtual machine" on page 240.

3 Complete the Take Recording dialog box that appears and click **OK**.

CAUTION While a recording is in progress, avoid exiting Workstation and allowing the virtual machine to run in the background. Doing so might cause the virtual machine to crash. Always stop recording before sending a virtual machine to run in the background.

4 When you want to stop recording, click the **Stop** button in the toolbar, or choose **VM>Replay>Stop**.

5 To change the name of the recording, add or change the description, or delete the recording, choose **VM>Snapshot>Snapshot Manager**.

To play back a recording

1 Select the virtual machine.

2 If it is powered on and you don't want to lose the current state of the virtual machine, take a snapshot of it.

For instructions, see "To take a snapshot" on page 234.

3 Do one of the following:

To play the latest recording of the virtual machine, click the **Replay Last Recording** button in the toolbar, or choose **VM>Replay>Replay Last Recording**.

To play an earlier recording, use the snapshot manager, as follows:

a Choose **VM>Snapshot>Snapshot Manager**.

b Select the recording snapshot you want to play and click **Replay**.

A snapshot of a recording is shown in Figure 10-4, "Snapshot Manager: Windows Host," on page 231.

4 In the dialog box that appears, confirm that you want to start replaying the recording.

5 (Optional) To slow down playback of the recording, see "To adjust the speed of playback" on page 243.

6 (Optional) To make a trace file of events that occurred during recording, see "To create an execution trace file of a recording" on page 244.

7 (Optional) To stop replaying the recording before it finishes playing, do one of the following:

- Choose **VM>Replay>Stop**.
- Click the **Stop** button in the **Replay** toolbar.
- Click inside the virtual machine, so that keyboard events are grabbed by the virtual machine, and press the L key ("go live" key).

You can then resume interacting with the virtual machine.

You cannot pause the recording or reverse it. If you stop the recording before it is finished replaying and then click the **Replay Last Recording** button again, the recording starts from its beginning, not from the point where you clicked **Stop**.

To adjust the speed of playback

1 To set all recordings for a virtual machine to begin playback in slow motion:

a Make sure the virtual machine is powered off.

b Add the following line to the configuration (`.vmx`) file for the virtual machine:

```
replay.halt_delay = "<microseconds>"
```

where `<microseconds>` is the number of microseconds that the virtual processor should halt when replaying. This setting controls halt emulation behavior. The default is 0, which means the recording plays in real time. The maximum value is 10000.

c Save and close the file.

During playback, if you want to speed up playback or slow it down even further, use the keyboard shortcuts described in Step 3.

NOTE This step is not a prerequisite to using keyboard shortcuts to speed up or slow down a recording. This step is useful if you want to slow recordings down by large increments, such as 10,000 rather than 100 or 200 microseconds.

---

2 Replay a recording, as described in "To play back a recording" on page 242.

3 To use keyboard shortcuts to slow down or speed up a recording:

a Click inside the virtual machine, so that keyboard events are grabbed by the virtual machine.

b Press one or more of the following keys to control the speed of replay:

- Down arrow – Slows down replay by 10 microseconds.
- Left arrow – Slows down replay by 100 microseconds.
- Up arrow – Accelerates replay by 10 microseconds, if it was previously slowed down.
- Right arrow – Accelerates replay by 100 microseconds, if it was previously slowed down.

Press the key repeatedly to slow down or speed up replay even further in 10- or 100-microsecond increments, depending on the key.

NOTE Keep in mind that the fastest speed for replay is real time. If you press the right-arrow key when the recording is slowed down by only 10 microseconds, then it will speed up by only 10 microseconds.

To create an execution trace file of a recording

1 Start playback of a recording, as described in "To play back a recording" on page 242.

2 To make an execution trace file of the recording, which records the events that occurred during recording, click inside the virtual machine, so that keyboard events are grabbed by the virtual machine, and press the T key ("trace" key).

A trace file is created in the directory where this virtual machine's configuration (`.vmx`) file is stored. The filename is `ReplayTrace-<timestamp>.gz`, where `<timestamp>` is the time at which you pressed the T key.

NOTE The speed at which the recording plays slows considerably while the trace file is being made.

---

3 To end the trace file, either press the T key again or click the **Stop** button in the **Replay** toolbar.

Otherwise, the trace file ends when the recording finishes playing.

If you press the T key to end the trace file before the recording ends and then press T again, another trace file is created.

To delete a recording

1 Select the virtual machine.

2 Choose **VM>Snapshot>Snapshot Manager**.

3 In the Snapshot Manager window, select the recording and click **Delete**.

Recordings can consume large amounts of disk space, depending on the activities of the virtual machine and the length of the recording. Delete recordings you don't need to retain.

11 Cloning a Virtual Machine

This chapter provides instructions for creating and configuring clones of virtual machines. This chapter includes the following topics:

- "Understanding Clones" on page 245
- "Creating Clones" on page 247
- "Working with Clones" on page 249

Understanding Clones

A clone is a copy of an existing virtual machine. The existing virtual machine is called the parent of the clone. When the cloning operation is complete, the clone is a separate virtual machine:

- Changes made to a clone do not affect the parent virtual machine. Changes made to the parent virtual machine do not appear in a clone.
- A clone's MAC address and UUID are different from those of the parent virtual machine.

To save the current state of the virtual machine, so that you can revert to that state, take a snapshot. To make a copy of a virtual machine for separate use, create a clone.

Although a clone is a separate virtual machine, if the clone is a linked clone, it shares virtual disks with the parent virtual machine. A more detailed explanation of linked clones appears in "Full and Linked Clones" on page 246.

Why Make a Clone?

Installing a guest operating system and applications can be time consuming. With clones, you can make many copies of a virtual machine from a single installation and configuration process.

Clones are useful when you must deploy many identical virtual machines to a group. For example:

- An MIS department can clone a virtual machine for each employee, with a suite of preconfigured office applications.
- A virtual machine can be configured with a complete development environment and then cloned repeatedly as a baseline configuration for software testing.
- A teacher can clone a virtual machine for each student, with all the lessons and labs required for the term.

With clones you can make complete copies of a virtual machine, without browsing a host file system or worrying if you have located all the configuration files.

Full and Linked Clones

There are two types of clones: full clones and linked clones.

Full Clones

A full clone is an independent copy of a virtual machine that shares nothing with the parent virtual machine after the cloning operation. Ongoing operation of a full clone is entirely separate from the parent virtual machine.

Because a full clone does not share virtual disks with the parent virtual machine, full clones generally perform better than linked clones. However, full clones take longer to create than linked clones. Creating a full clone can take several minutes if the files involved are large.

Linked Clones

A linked clone is a copy of a virtual machine that shares virtual disks with the parent virtual machine in an ongoing manner. A linked clone is made from a snapshot of the parent. (See "Snapshot Processes: Linear Versus Process Tree" on page 225.) This conserves disk space and allows multiple virtual machines to use the same software installation.

All files available on the parent at the moment of the snapshot continue to remain available to the linked clone. Ongoing changes to the virtual disk of the parent do not affect the linked clone, and changes to the disk of the linked clone do not affect the parent.

A linked clone must have access to the parent. Without access to the parent, you cannot use a linked clone at all. See "Linked Clones and Access to the Parent Virtual Machine" on page 250.

Linked clones are created swiftly, so you can easily create a unique virtual machine for each task you have. You can also easily share a virtual machine with other users by storing the virtual machine on your local network, where other users can quickly make a linked clone. This facilitates collaboration: for example, a support team can reproduce a bug in a virtual machine, and an engineer can quickly make a linked clone of that virtual machine to work on the bug.

Full Clones and Snapshots of the Parent

A full clone is a complete and independent copy of a virtual machine. However, the full clone duplicates only the state of the virtual machine at the instant of the cloning operation. Thus the full clone does not have access to any snapshots that might exist of the parent virtual machine.

Creating Clones

The Clone Virtual Machine wizard guides you through the process of making a clone. You do not need to locate and manually copy the parent virtual machine files. The Clone Virtual Machine wizard automatically creates a new MAC address and other unique identifiers for the clone.

NOTE Workstation 4 virtual machines, and virtual machines created with other VMware products that are compatible with version 4, must be upgraded to at least Workstation version 5 virtual machines before you can clone them. See "Changing the Version of the Virtual Machine" on page 59.

To create a clone using the Clone Virtual Machine wizard

1 If you want to make a linked clone, defragment the guest operating system's drives before creating the linked clone.

Use the tools in the guest operating system to run a defragmentation utility.

For more information, see "Performance Impact of Defragmenting Snapshots and Linked Clones" on page 383.

2 Power off the virtual machine that you want to clone.

You cannot create a clone from a virtual machine that is powered on or suspended.

3 Click the name of a virtual machine you want to clone in the **Favorites** list or click the tab of a virtual machine in the summary window.

4 From the Workstation menu bar, choose **VM>Clone** to open the Clone Virtual Machine wizard.

5 On the Welcome page, click **Next**.

6 On the Clone Source page, select the state of the parent from which you want to create a clone and click **Next**.

You can choose to create a clone from:

- The parent's current state. Workstation creates a snapshot of the virtual machine before cloning it.
- Any snapshot of the parent. Select the snapshot name from a drop-down menu of existing snapshots.

7 On the Clone Type page, specify whether you want to create a linked clone or a full clone and click **Next**.

See "Full and Linked Clones" on page 246 for a description of the differences.

8 On the Name of the New Virtual Machine page, enter a name and a path for the cloned virtual machine and click **Finish**.

The default name and path are based on the original virtual machine name and location. You can type a new entry for name and path, or browse to a directory for the clone files.

The Clone Virtual Machine wizard displays a status page. A full clone can take many minutes to create, depending on the size of the virtual disk that is being duplicated.

9 Click **Done** to exit the Clone Virtual Machine wizard.

Working with Clones

This section discusses the following topics:

- "Making a Linked Clone of a Linked Clone" on page 249
- "Making a Full Clone of a Linked Clone" on page 249
- "Network Identity for a Clone" on page 249
- "Linked Clone Snapshot" on page 250
- "Linked Clones and Access to the Parent Virtual Machine" on page 250

Making a Linked Clone of a Linked Clone

It is possible to make a linked clone from a linked clone, using the Clone Virtual Machine wizard. Keep these cautions in mind:

- Performance degrades when you do this. When possible, make a linked clone of the parent virtual machine.
- To power on and work with a linked clone of a linked clone, Workstation must be able to locate all ancestors in the chain. See "Linked Clones and Access to the Parent Virtual Machine" on page 250.

Making a Full Clone of a Linked Clone

It is possible to make a full clone from a linked clone, using the Clone Virtual Machine wizard. The linked clone can be used as before. The full clone created with this action is an independent virtual machine that does not require access to the linked clone or its ancestors.

To make a full clone from a linked clone, Workstation must have access to the linked clone and all ancestors at the time you run the Clone Virtual Machine wizard. Refer to "Linked Clones and Access to the Parent Virtual Machine" on page 250.

Network Identity for a Clone

The Clone Virtual Machine wizard creates a new MAC address for the cloned virtual machine. Other configuration information is identical to that of the parent virtual machine. For example, a machine's name and static IP address configuration are not altered by the Clone Virtual Machine wizard.

To prevent conflict with static IP addressing, change the clone's static IP address before the clone connects to the network. See "Selecting IP Addresses on a Host-Only Network or NAT Configuration" on page 289.

Linked Clone Snapshot

When you create a linked clone, Workstation creates a snapshot of the parent virtual machine. This snapshot preserves the exact state of the virtual machine when you create the clone.

WARNING You cannot delete the linked clone snapshot without destroying the linked clone. It is safe to delete this snapshot only if you have deleted the clone depending on it.

The snapshot manager allows you to rename any snapshot. If you rename a snapshot for a cloned virtual machine, use the **Description** field to aid you in future identification. See "Working with Snapshots in the Snapshot Manager" on page 231 for more information on renaming snapshots.

Linked Clones and Access to the Parent Virtual Machine

You cannot power on or resume a linked clone if Workstation fails to locate the parent virtual machine. This section discusses the issues related to accessing the necessary files.

Moving a Linked Clone

You can move a linked clone or its parent within a file system or network, but you must ensure that Workstation can continue to access the clone and the parent virtual machine.

Place the parent in a shared directory or on a network file server so Workstation can use the linked clone from any host computer with network access. See "Moving and Sharing Virtual Machines" on page 185.

For example, if you put a linked clone on a laptop, and the parent remains on another machine, you can use the clone only when the laptop connects to the network or drive where the parent is stored. To use a cloned virtual machine on a disconnected laptop, you must use a full clone or you must move the parent virtual machine to the laptop.

Protecting the Parent of Linked Clones

To prevent anyone from deleting the parent virtual machine for a linked clone, designate the parent as a template. The two parts of the process are discussed in the following sections:

- "To enable template mode using the virtual machine settings editor" on page 251
- "To create a linked clone from a template" on page 251

To enable template mode using the virtual machine settings editor

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Advanced**.

4 In the Settings section, click **Enable Template mode (to be used for cloning)** and click **OK**.

With template mode enabled, a virtual machine cannot be deleted or added to a team, and the virtual machine's snapshots cannot be deleted.

To create a linked clone from a template

1 Select the virtual machine to use as a parent of your linked clone.

2 Verify that the parent has at least one snapshot.

Open the snapshot manager and create a snapshot if none exists.

3 Verify that template mode has been enabled.

See "To enable template mode using the virtual machine settings editor" on page 251.

4 With the virtual machine still selected, launch the Clone Virtual Machine wizard by choosing **VM>Clone** from the Workstation menu bar.

5 Click **Next** to display the Clone Source page.

6 Select a snapshot from the drop-down menu and click **Next**.

The wizard does not allow you to clone from the current state when the virtual machine has template mode enabled.

7 Name the linked clone and click **Finish**.

Workstation creates the linked clone and displays a status page.

8 Click **Done** to exit the wizard.

Configuring Teams 12

This chapter describes what virtual machine teams are used for, how to create them, and how to configure them. This chapter includes the following topics:

- "Benefits of Using Teams" on page 253
- "Creating a Team" on page 255
- "Opening and Closing a Team" on page 256
- "Changing the Name of a Team" on page 257
- "Deleting a Team" on page 257
- "Viewing Teams and Their Virtual Machines" on page 258
- "Adding and Removing Team Virtual Machines" on page 260
- "Setting the Startup Sequence for a Team" on page 261
- "Starting and Stopping Teams" on page 262
- "Working with Team Networks" on page 264
- "Cloning and Taking Snapshots of Team Members" on page 269

Benefits of Using Teams

Workstation teams allow you to set up a virtual computer lab on one host computer. Teams enable you to power on multiple associated virtual machines with a single click.

Team settings control the startup order and timing for team virtual machines. You can set up specific delays between booting virtual machines so the host CPU load is spread out. Teams automatically launch virtual machines in the right order, with delays that you specify to ensure that each virtual machine stabilizes before the next virtual machine boots.

Team virtual machines can use networking just as other virtual machines can. In addition, team members can communicate in private networks called LAN segments. LAN segments are completely independent of, and invisible to, the host computer's network.

You can use teams to:

- **Virtualize multitier environments** – Start separate client, server, and database virtual machines with one click. Configure startup delay times so clients don't submit queries before the server is ready.
- **Virtualize multiple-machine testing environments** – Set up a software package for QA on a virtual machine, and configure automation on other virtual machines to test the first.
- **Virtualize network performance and security –** LAN segments offer enhanced performance and security. A team LAN segment is fully contained. It is undetectable and inaccessible from any other network, inside or outside the team. Team networking lets you:
  - Isolate a team completely from the host network.
  - Create a virtual DMZ or proxy server to securely bridge the team members to the outside network.
  - Allow specific network bandwidth and packet loss to each virtual machine on the team.
  - Connect all team members fully to host resources.

  You control all traffic allowed between the host network and team virtual machines.
- **Monitor multiple virtual machines –** Use thumbnail views of the virtual machine displays to review activity on team virtual machines simultaneously.

Creating a Team

Use the New Team wizard to create a team and add virtual machines.

To create a team

1 To add virtual machines to the team while completing the New Team wizard:

- Power off any virtual machines that you want to add to the team.
- Power off any virtual machines that you want to clone if you intend to create a clone and add it to the team.

You can instead add virtual machines later, after you create the team, by using the **Team** menu.

2 From the Workstation menu bar, open the New Team wizard by choosing **File>New>Team**.

3 Complete the New Team wizard that appears.

Completing the wizard involves specifying the following things:

- The name of the team and location of the virtual team files. By default, the team files are stored in the same directory as virtual machines, as described in "Virtual Machine Location" on page 150.
- Whether you want to add virtual machines to the team now or later. If you want to add them now, you have the following options:
  - **New Virtual Machine** – Launches the New Virtual Machine wizard. See "Setting Up a New Virtual Machine" on page 87.
  - **Existing Virtual Machine** – Opens a file browser from which you can navigate the host file system to locate an existing `.vmx` file.

    When you add a virtual machine to a team it can no longer be accessed outside the team. For more information, see "Adding and Removing Team Virtual Machines" on page 260.
  - **New Clone of Virtual Machine** – Opens a file browser from which you can navigate the host file system to locate an existing `.vmx` file. After you select a virtual machine, Workstation launches the Clone Virtual Machine wizard. See "Creating Clones" on page 247.

NOTE Workstation version 4 virtual machines cannot be added to teams.

- Whether you want to add one or more LAN segments. If you add LAN segments while creating the team, you change default names and bandwidth later, as described in "Configuring LAN Segments" on page 267.

  You can instead add LAN segments later, after you create the team, by using the **Team** menu. For information about LAN segments, see "Working with Team Networks" on page 264.

After the team is created, you can add it to the **Favorites** list. Use the **Team** menu to configure the team further, or to add and remove virtual machines.

Opening and Closing a Team

Opening a team displays its summary window but does not power on the virtual machines included in the team.

Closing a team removes its summary window. Depending on how you set Workstation preferences, closing a team might require powering off the team. For information about this preference, see "Closing Virtual Machines and Exiting Workstation" on page 84. To delete a team permanently, see "Deleting a Team" on page 257.

To open a team

1 From the Workstation menu bar, choose **File>Open**.

2 Browse to the location of the `.vmtm` file for the team you want.

3 Select the file and click **Open**.

  The selected team appears as a tabbed item in the summary window.

4 To add the team to the **Favorites** list, choose **File>Add to Favorites**.

  After a team is added to the **Favorites** list, open it by clicking it in the **Favorites** list.

To close a team

1 Power off the team, as described in "Powering a Team On and Off" on page 262.

2 Select the team to close.

  Click the summary/console tab for the desired team, or select the team name in the **Favorites** list.

3 Choose **File>Close**.

4 If any of the team's virtual machines are still powered on and you are prompted about whether you want to power them off or let them run in the background, click the button you want.

For more information, see "Closing Virtual Machines and Exiting Workstation" on page 84.

The closed team is removed from the summary window. To remove the team from the **Favorites** list, see "To remove a name from the Favorites list" on page 75.

Changing the Name of a Team

When you create a team, the name of the directory where the team (`.vmtm`) file is stored is based on the name you originally give the team. Although you can change the name of the team, the name of this file does not change.

To change the name of a team

Do one of the following:

- If the team is in the **Favorites** list, right-click it and choose **Rename**. Type the new name and press Enter.
- Open the team or select the team in the **Favorites** list and choose **Team>Settings>Options**. Type a new name in the **Team name** field and click **OK**.

Deleting a Team

When you delete a team, you can choose to delete:

- Only the team (retaining the virtual machines in the team)
- The team and the virtual machines in the team

WARNING Deleting a team permanently removes the team files from the host file system and removes associated LAN segments from all virtual machines. Deleting the team's virtual machines along with the team removes the virtual machine files permanently.

To remove a team from the Workstation window without deleting the team, see "Opening and Closing a Team" on page 256.

To delete a team

1 Make sure the team is powered off.

2 Open the team or select the team in the **Favorites** list, and from the Workstation menu bar, choose **Team>Delete from Disk**.

3 Do one of the following:

- To delete the team without deleting the virtual machines in it, choose **Delete**.
- To delete the team and the virtual machines in it, choose **Delete Team and VMs**.

When you delete a team, you also delete all team LAN segments. The virtual Ethernet adapters associated with deleted LAN segments become disconnected. Bridged, host-only, NAT, and custom configurations remain unchanged.

4 Click **OK**.

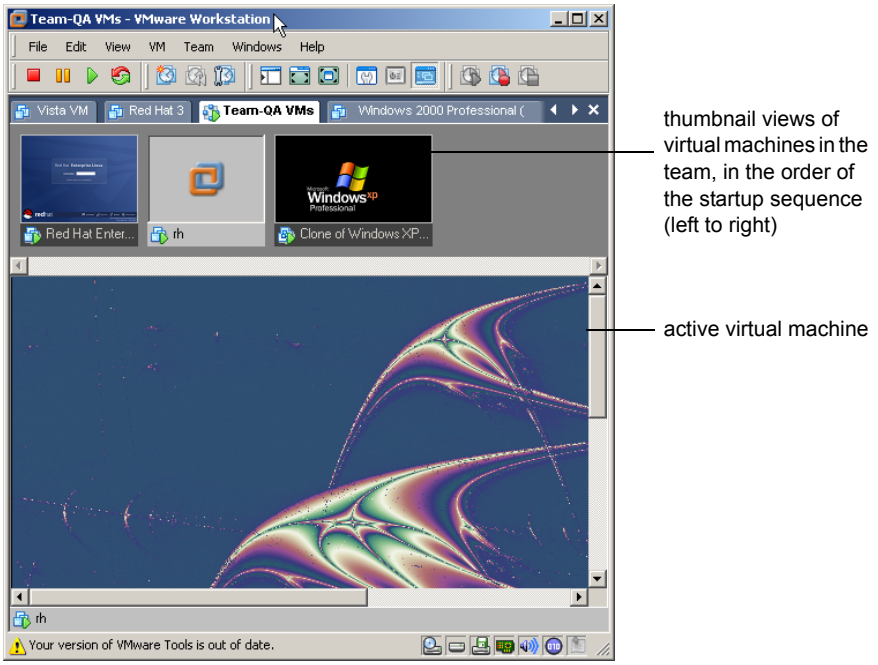
The team is removed permanently from Workstation and the host file system. If you chose **Delete Team and VMs**, the virtual machines in the team are also removed permanently from Workstation and the host file system.

Viewing Teams and Their Virtual Machines

Workstation displays teams in a summary view or console view:

- The summary view is available at any time. See "Summary View" on page 66.
- The console view is available only when a team is powered on. A grab bar allows you to resize the areas.

Figure 12-1. Console Window for a Team (Windows Host)


Team-QA VMs - VMware Workstation
File Edit View VM Team Windows Help
Vista VM
Red Hat 3
Team-QA VMs
Windows 2000 Professional (
Red Hat Enter...
rh
Clone of Windows XP...
rh
Your version of VMware Tools is out of date.
thumbnail views of virtual machines in the team, in the order of the startup sequence (left to right)
active virtual machine

You might need to scroll the thumbnails to view all your virtual machines on a large team. The thumbnails are displayed in the same order as the team's startup sequence, starting on the left with the first virtual machine in the sequence.

Workstation updates thumbnails in real time, to display the actual content of the virtual machine screens. The active virtual machine is the one that appears in the lower pane of the console. Its thumbnail is represented by the **VMware** icon.

Workstation menus and commands directly affect only the active virtual machine, and you can use the mouse and keyboard to interact directly with the active virtual machine.

Click a thumbnail of a virtual machine or use the **Team>Switch To** menu and then select the virtual machine that you want to make active. The virtual machine you select appears in the lower pane of the console, and its thumbnail becomes the **VMware** icon.

In full screen mode, Workstation displays only the active virtual machine. See "Using Full Screen Mode" on page 156.

Adding and Removing Team Virtual Machines

This section provides instructions for adding virtual machines to teams and removing them from teams.

Consider these issues when you add a virtual machine to a team:

- A virtual machine is not powered on when you add it to a running team. You must power on the added virtual machine manually to use it during the current session. The added virtual machine is thereafter powered on or off with the rest of the team.
- When you add a virtual machine to a team, you can no longer operate the virtual machine outside the team. Adding a virtual machine to a team therefore removes it from the **Favorites** list.

NOTE Workstation version 4 virtual machines cannot be added to teams.

To add a virtual machine to a team

1. Make sure that any existing virtual machines that you want to add or clone are powered off.
2. Open the team or select the team in the **Favorites** list.
3. From the Workstation menu bar, choose **Team>Add** and select one of the following options:
   - **New Virtual Machine** – Launches the New Virtual Machine wizard. See "Setting Up a New Virtual Machine" on page 87.
   - **Existing Virtual Machine** – Opens a file browser from which you can navigate the host file system to locate an existing `.vmx` file.

     When you add a virtual machine to a team it can no longer be accessed outside the team.
   - **New Clone of Virtual Machine** – Opens a file browser from which you can navigate the host file system to locate an existing `.vmx` file. After you select a virtual machine, Workstation launches the Clone Virtual Machine wizard. See "Creating Clones" on page 247.

To remove a virtual machine from a team

1 Make sure that any virtual machines that you want to remove are powered off.

2 Open the team or select the team in the **Favorites** list.

3 From the Workstation menu bar, choose **Team>Remove><virtual machine name>**.

The selected virtual machine is removed from the team. You can now use it independently.

NOTE When you remove a virtual machine from a team, you also remove it from team LAN segments. Virtual network adapters associated with LAN segments become disconnected. Bridged, host-only, NAT, and custom configurations remain unchanged.

To completely delete a virtual machine and erase its files from the host file system, see "Deleting a Virtual Machine" on page 154.

When you add a virtual machine to a team, it is removed from the **Favorites** list. A virtual machine is not automatically added to the **Favorites** list when you remove it from a team. You must manually add it, as described in "To add a virtual machine or team entry to the Favorites list" on page 75.

Setting the Startup Sequence for a Team

In the startup sequence, you can specify:

- **The order in which virtual machines start and stop –** Team virtual machines start one at a time, in the order you set in the startup sequence. Setting the startup sequence is useful, for example, if you have a virtual machine that runs an application to be tested and you want it to start before the virtual machines running an automated testing script.
- **The delay between team members in the sequence –** Set the time that Workstation delays after starting or stopping a virtual machine, before starting or stopping the next virtual machine in the sequence. This delay avoids overloading the CPU when multiple virtual machines start and allows applications on a virtual machine to launch before another team virtual machine attempts to connect.

  You might also use this delay to ensure that a virtual machine functioning as a server completes its startup before client virtual machines start. If your virtual machine team depends on precise startup timing, experiment to determine how much time your host and guest operating environments and applications need to launch.

The startup sequence applies to power on, power off, suspend, and resume operations.

- Power on and resume operations for virtual machines occur in the order of the sequence shown in the team settings list.
- Power off and suspend operations for virtual machines occur in the reverse of the order shown in the team settings list.

To set the startup sequence for members of a team

1 Open the team or select the team in the **Favorites** list.

2 From the Workstation menu bar, choose **Team>Settings** and click the **Virtual Machines** tab.

3 Use the up and down arrow buttons to arrange the virtual machines in the list. The virtual machine at the top of the list is the first in the startup sequence.

4 Select each virtual machine and specify how many seconds you want it to wait before starting the next virtual machine.

NOTE This "startup" delay is applied to power on, power off, suspend, and resume operations.

5 Click **OK** to save your changes.

Starting and Stopping Teams

Power operations for teams are much the same as those for an individual virtual machine. However, for a team, you can also configure the sequence in which the members of a team power on and off. See "Setting the Startup Sequence for a Team" on page 261.

You can also use Workstation's command-line application for team power operations. See Chapter A, "Workstation Command-Line Reference," on page 403.

Powering a Team On and Off

When you power a team on or off, the virtual machines in the team power on or off in the startup sequence specified in the team settings editor (from the Workstation menu bar, choose **Team>Settings>Virtual Machines**). See "Setting the Startup Sequence for a Team" on page 261.

To power a team on or off

1 Select the team either from the **Favorites** list or by clicking the summary tab for the team.

2 Do one of the following:

- In the Workstation toolbar, click the **Power On** button or the **Power Off** button, as appropriate.
- From the Workstation menu bar, choose one of the **Team>Power** options.

When you power off a team, the default settings for a virtual machine can cause the guest operating system to terminate abruptly. For information about configuring your virtual machine to recognize the shut down guest command when you power off a team, see "Shutting Down a Virtual Machine" on page 152.

Suspending and Resuming a Team

When you suspend a team, all team virtual machines start suspending simultaneously. The startup sequence determines the order in which virtual machines are resumed, and the time Workstation delays after each team member is resumed, before resuming the next team member. See "Setting the Startup Sequence for a Team" on page 261.

If you attempt to close Workstation while a team suspend or resume operation is still in progress, a warning dialog box appears.

To suspend or resume a team

1 Select the team either from the **Favorites** list or by clicking the summary tab for the team.

2 Do one of the following:

- In the Workstation toolbar, click the **Suspend** button or the **Resume** button, as appropriate.
- From the Workstation menu bar, choose one of the **Team>Power** options.

All team virtual machines start suspending simultaneously. A progress indicator appears for each team member. To see the progress of a particular team member, choose **Team>Switch To><virtual machine name>**.

The time to complete the operation varies with the size of the virtual machines.

Power Operations for Individual Members of a Team

Performing a power operation for one member of a team is similar to performing the operation for a virtual machine that is not part of the team, except that instead of selecting the machine from the **Favorites** list, you select it from the team's console.

To perform power operations for a single virtual machine in a team

1 Select the virtual machine from the team's console.

2 Do one of the following:

- Choose the appropriate command from the **VM>Power** menu.
- From the Workstation menu bar, choose one of the **Team>Power** options.

For more information see:

- "Starting a Virtual Machine" on page 148
- "Shutting Down a Virtual Machine" on page 152
- "Using the Suspend and Resume Features" on page 223
- "Powering Off Versus Shutting Down and Resetting Versus Restarting" on page 152

Working with Team Networks

One of the advantages of teams is the ability to isolate virtual machines in private virtual networks, called LAN segments. This can be useful with multitier testing, network performance analysis, and situations where isolation and packet loss are important.

This section focuses on LAN segments. For information about other aspects of networking, see Chapter 13, "Configuring a Virtual Network," on page 271.

LAN Segment Requirements

The following sections describe the requirements for virtual machines connecting to a LAN segment.

Network Adapter

A physical PC must have a network adapter for each physical network connection. Similarly, a virtual machine must be configured with a virtual network adapter for each LAN segment it interacts with. To connect a virtual machine to multiple LAN segments simultaneously, you must configure that virtual machine with multiple network adapters. See "Adding and Removing Ethernet Adapters" on page 266.

LAN Segment IP Addresses

Each network client must have an IP address for TCP/IP networking. Unlike host-only and NAT networking, LAN segments have no DHCP server provided automatically by Workstation. Therefore you must manually configure IP addressing for team virtual machines on a LAN segment. There are two choices:

- **DHCP** – Configure a DHCP server on your LAN segment to allocate IP addresses to your virtual machines.
- **Static IP** – Configure a fixed IP address for each virtual machine on the LAN segment.

When you add an existing virtual machine to a team, the virtual machine might be configured to expect an IP address from a DHCP server. A DHCP server is not automatically provided for a virtual LAN segment. You must provide a DHCP server on the LAN segment, or reconfigure the virtual machine to use a static IP address. See "Configuring a Virtual Network" on page 271.

Creating a Team LAN Segment

The first step to creating a virtual network for a team is to add and name a LAN segment. You can then configure connections to this segment.

To create a virtual network for a team

1 Open the team or select the team in the **Favorites** list.

2 From the Workstation menu bar, choose **Team>Add>LAN Segment**.

3 Enter a name for the private network and click **OK**.

You can configure the other settings in this dialog box later, as described in "Configuring LAN Segments" on page 267.

The LAN segment is added to the team.

Now that the LAN segment is created, you can create a network adapter to connect to it, as described in "Adding and Removing Ethernet Adapters" on page 266.

Adding and Removing Ethernet Adapters

Use the following procedure to create an adapter to connect to a LAN segment.

To add or remove an Ethernet adapter

1 Power off the virtual machine that you want to add an adapter to or remove an adapter from.

2 Select the team either from the **Favorites** list or by clicking the summary tab for the team.

3 From the Workstation menu bar, choose **Team>Settings** and click the **Connections** tab.

4 To add an adapter, select the virtual machine and click **Add Adapter**.

The added adapter is displayed in the **Adapters** column.

5 To use the adapter to connect to a LAN segment, select the check box that corresponds to the LAN segment.

If you need to first create a LAN segment, see "Creating a Team LAN Segment" on page 265.

6 To remove an adapter, select the adapter you want to remove and click **Remove Adapter**.

7 Click **OK**.

Now that you have added a network adapter, you can use it to configure connections, as described in "Configuring Connections for a LAN Segment" on page 267.

Configuring Connections for a LAN Segment

This section describes how to configure connections for virtual Ethernet adapters.

To connect a virtual machine to a LAN segment

1 If you have not yet created a LAN segment, do so, as described in "Creating a Team LAN Segment" on page 265.

2 Open the team or select the team in the **Favorites** list.

3 From the Workstation menu bar, choose **Team>Settings** and click the **Connections** tab.

Each virtual Ethernet adapter is displayed in a separate row.

If no Ethernet adapters appear on this tab, add one, as described in "Adding and Removing Ethernet Adapters" on page 266.

4 For each virtual Ethernet adapter, select the check box that corresponds to the LAN segment and click **OK**.

The virtual machine is now connected to the selected LAN segment. Continue on to "Configuring LAN Segments" on page 267.

Configuring LAN Segments

You can configure network transmission properties for a LAN segment, including bandwidth settings such as connection type and speed, as well as percentage of packet loss allowed.

To configure LAN segments for a team

1 Select the team either from the **Favorites** list or by clicking the summary tab for the team.

2 From the Workstation menu bar, choose **Team>Settings**.

3 Click the **LAN Segments** tab, and complete the fields.

From this tab you can add, remove, and rename the LAN segments configured for the team.

The list in the left pane displays LAN segments associated with the team.

4 Click a name to select the LAN segment you want to configure.

The right pane displays parameters for the physical properties of the emulated LAN segment link:

- **Name** – Name of the LAN segment. To change the name, type a new name in the **Name** field.
- **Bandwidth** – Drop-down menu of bandwidths for typical network links. To change the bandwidth, choose another connection type from the drop-down menu.
- **Kbps** – Set a custom bandwidth. Changes here are overwritten when you make a selection from the **Bandwidth** menu. To change the bandwidth, type a number into the field.
- **Packet Loss** – A specification of the efficiency or faultiness of the link, measured in the percentage of packets lost from the total number of packets transmitted. To change the packet loss setting, type a number into the field.

5 Click **OK** to save your changes.

NOTE LAN settings changes are ignored by virtual machines that are currently running. Changes to LAN settings become active for a given virtual machine only after that virtual machine is powered on, reset, or resumed.

Deleting a LAN Segment

Deleting a LAN segment disconnects all virtual Ethernet adapters that are configured for that LAN segment. When you remove a virtual machine from a team, you must manually configure its disconnected virtual Ethernet adapter if you want to reconnect the virtual machine to a network.

To delete a LAN segment from a team

1 Select the team either from the **Favorites** list or by clicking the summary tab for the team.

2 From the Workstation menu bar, choose **Team>Settings** and click the **LAN Segments** tab.

3 Select the LAN segment you want to delete.

4 Click **Remove**.

The LAN segment is removed.

Cloning and Taking Snapshots of Team Members

You can clone a virtual machine in a team in the same way you clone any other virtual machine. See "Creating Clones" on page 247. When you clone a virtual machine in a team:

- The resulting clone is not part of the team.
- The clone appears on the **Favorites** list as well as in a summary window.
- If the parent virtual machine is configured for a LAN segment, the virtual Ethernet adapter for that LAN segment on the clone is disconnected. To connect to a network, you must reconfigure the virtual Ethernet adapter manually.

Snapshots operate on virtual machines, not on the whole team. When a team is active, the **Snapshot** button on the toolbar takes a snapshot of only the active virtual machine.

To preserve the state of all virtual machines on a team, power off the team, and take a snapshot of each virtual machine before you power on the team again.

Configuring a Virtual Network

13

The first topics in this chapter preview the virtual networking components that VMware Workstation provides and show how you can use them with your virtual machine. The rest of the chapter provides more detail on networking capabilities and specialized configurations.

This chapter includes the following topics:

- "Network Basics" on page 272
- "Components of the Virtual Network" on page 273
- "Common Networking Configurations" on page 274
- "Example of a Custom Networking Configuration" on page 278
- "Changing a Networking Configuration" on page 282
- "Advanced Networking Topics" on page 289
- "Using NAT" on page 304
- "Using Samba with Workstation" on page 316

Network Basics

VMware Workstation provides several ways you can configure a virtual machine for virtual networking:

- **Bridged networking** – Configures your virtual machine as a unique identity on the network, separate from and unrelated to its host. Other computers on the network can then communicate directly with the virtual machine. Bridged networking works with Ethernet, DSL, cable, wireless, and legacy phone modems. See "Bridged Networking" on page 274.
- **Network address translation (NAT)** – Configures your virtual machine to share the IP and MAC addresses of the host. The virtual machine and the host share a single network identity that is not visible outside the network. NAT can be useful when you are allowed a single IP address or MAC address by your network administrator. You might also use NAT to configure separate virtual machines for handling HTTP and FTP requests, with both virtual machines running off the same IP address or domain.

  NAT works with Ethernet, DSL, and legacy phone modems. See "Network Address Translation (NAT)" on page 276.
- **Host-only networking** – Configures your virtual machine to allow network access only to the host. With host-only networking, the virtual machine can communicate only with the host and other virtual machines in the host-only network. This can be useful when you want a secure virtual machine that is connected to the host network, but available only through the host machine. In this configuration, the virtual machine cannot connect to the Internet. See "Host-Only Networking" on page 277.
- **Custom networking** – Lets you configure your virtual machine's network connection manually. On Windows hosts, you can use the virtual network editor to access multiple network cards in your host and create multiple virtual networks. See "Example of a Custom Networking Configuration" on page 278.

If you select the Typical setup path in the New Virtual Machine wizard, the wizard sets up bridged networking for the virtual machine. Select the Custom setup path to choose any of the other common configurations: bridged networking, network address translation (NAT), and host-only networking. The wizard connects the virtual machine to the appropriate virtual network.

You can set up more specialized configurations by choosing the appropriate settings in the virtual machine settings editor, in the virtual network editor (on Windows hosts), and on your host computer.

On a Windows host, the software needed for all networking configurations is installed when you install Workstation. On a Linux host, when you install and configure Workstation, you can choose whether to have bridged, host-only, and NAT networking available to your virtual machines: You must choose all options during configuration to make all networking configurations available for your virtual machines.

Components of the Virtual Network

The following sections describe the devices that make up a virtual network.

Virtual Switch

Like a physical switch, a virtual switch lets you connect other networking components together. Virtual switches are created as needed by Workstation, up to a total of 10 virtual switches on Windows and 256 on Linux. You can connect one or more virtual machines to a switch.

By default, a few of the switches and the networks associated with them are used for special named configurations:

- The bridged network uses VMnet0, as described in "Bridged Networking" on page 274.
- The host-only network uses VMnet1, as described in "Host-Only Networking" on page 277.
- The NAT network uses VMnet8, as described in "Network Address Translation (NAT)" on page 276.

The other available networks are named VMnet2, VMnet3, VMnet4, and so on.

To find out which type of network a virtual machine is using, select the virtual machine, and from the Workstation menu bar, choose **VM>Settings>Hardware**, and select the Ethernet adapter. The **Network Connection** section displays the details. You can change the setting. To add another adapter, see "Adding and Modifying Virtual Network Adapters" on page 282.

DHCP Server

The DHCP (dynamic host configuration protocol) server provides IP network addresses to virtual machines in configurations that are not bridged to an external network. For example, host-only and NAT configurations use the DHCP server.

Network Adapter

One virtual network adapter is set up for your virtual machine when you create it with the New Virtual Machine wizard using any type of networking. It appears to the guest operating system as an AMD PCNET PCI adapter or as an Intel Pro/1000 MT Server Adapter. On Windows Vista guests, it is an Intel Pro/1000 MT Server Adapter.

You can create and configure up to 10 virtual network adapters in each Workstation 6 virtual machine by using the virtual machine settings editor. The limit is 3 adapters for Workstation 4 or 5 virtual machines. For more information, see "Adding and Modifying Virtual Network Adapters" on page 282.

Common Networking Configurations

The following sections illustrate the networking configurations that are set up for you automatically when you choose the standard networking options in the New Virtual Machine wizard or the virtual machine settings editor.

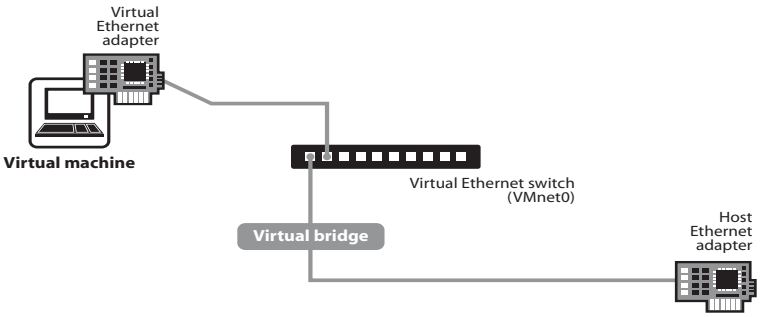
Only one virtual machine is shown in each example, but multiple virtual machines can be connected to the same virtual Ethernet switch. On a Windows host, you can connect an unlimited number of virtual network devices to a virtual switch. On a Linux host, you can connect up to 32 devices.

Bridged Networking

Bridged networking connects a virtual machine to a network by using the host computer's Ethernet adapter. If your host computer is on an Ethernet network, this is often the easiest way to give your virtual machine access to that network. The virtual Ethernet adapter in the virtual machine connects to the physical Ethernet adapter in your host computer, allowing it to connect to the LAN used by the host computer.

Bridged networking makes the virtual machine visible to other computers on the network, and they can communicate directly with the virtual machine. Bridged networking works with Ethernet, DSL, and legacy phone modems.

Figure 13-1. Bridged Networking Setup



How to Set Up Bridged Networking

Bridged networking is set up automatically if you select **Use bridged networking** in the New Virtual Machine wizard or if you select the Typical setup path. This selection is available on a Linux host only if you enable the bridged networking option when you install Workstation. You can set up additional virtual bridges for custom configurations that require connections to more than one physical Ethernet adapter on the host computer. Linux and Windows hosts can use bridged networking to connect to both wired and wireless networks.

Requirements for IP Addresses

If you use bridged networking, your virtual machine must have its own identity on the network. For example, on a TCP/IP network, the virtual machine needs its own IP address. Your network administrator can tell you whether IP addresses are available for your virtual machine and which networking settings you should use in the guest operating system. Generally, your guest operating system can acquire an IP address and other network details automatically from a DHCP server, or you might need to set the IP address and other details manually in the guest operating system.

If you use bridged networking, the virtual machine is a full participant in the network. It has access to other machines on the network and can be contacted by other machines on the network as if it were a physical computer on the network.

Be aware that if the host computer is set up to boot multiple operating systems and you run one or more of them in virtual machines, you need to configure each operating system with a unique network address. People who boot multiple operating systems often assign all systems the same address, since they assume only one operating system will be running at a time. If you use one or more of the operating systems in a virtual machine, this assumption is no longer true.

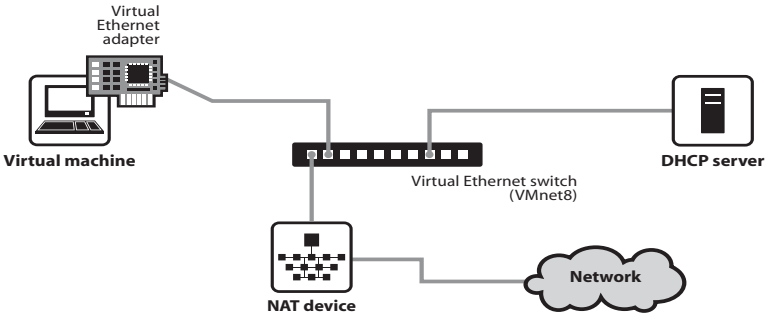
How to Edit the Setting Later

If you make another selection in the New Virtual Machine wizard and later decide you want to use bridged networking, make that change in the virtual machine settings editor (from the Workstation menu bar, choose **VM>Settings>Hardware>Ethernet**). See "Changing a Networking Configuration" on page 282.

Network Address Translation (NAT)

NAT gives a virtual machine access to network resources by using the host computer's IP address. If you are not able to give your virtual machine an IP address on the external network, you might find that NAT is the easiest way to give your virtual machine access to the Internet or other TCP/IP network. NAT uses the host computer's dial-up networking or broadband connection.

Figure 13-2. Network Address Translation Setup



If you select NAT, the virtual machine can use many standard TCP/IP protocols to connect to other machines on the external network. For example, you can use HTTP to browse Web sites, FTP to transfer files, and Telnet to log on to other computers. NAT also allows you to connect to a TCP/IP network using a Token Ring adapter on the host computer.

In the default configuration, computers on the external network cannot initiate connections to the virtual machine. That means, for example, that the default configuration does not let you use the virtual machine as a Web server to send Web pages to computers on the external network. This configuration has the advantage of protecting the guest operating system from being compromised before you have a chance to install security software. For example, it is often recommended that for Windows guest operating systems, you use NAT until you install antivirus software.

How to Set Up NAT

A NAT connection is set up automatically if you select the Custom setup in the New Virtual Machine wizard and select **Use network address translation**. On a Linux host, you must choose to make NAT available to your virtual machines when you install Workstation.

Requirements for IP Addresses

If you use NAT, your virtual machine does not have its own IP address on the external network. Instead, a separate private network is set up on the host computer. Your virtual machine gets an address on that network from the VMware virtual DHCP server. The VMware NAT device passes network data between one or more virtual machines and the external network. It identifies incoming data packets intended for each virtual machine and sends them to the correct destination.

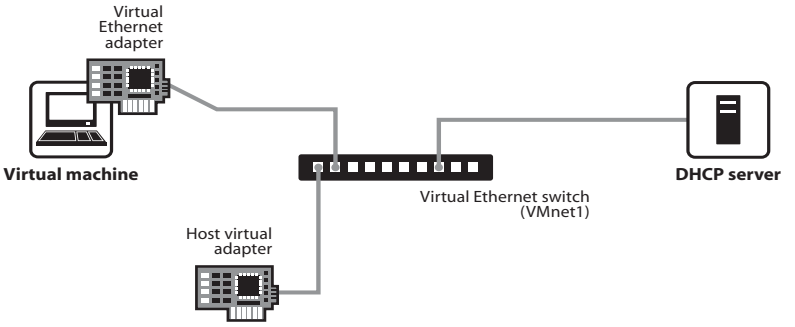
How to Edit the Setting Later

If you make some other selection in the New Virtual Machine wizard and later decide you want to use NAT, you can make that change in the virtual machine settings editor (from the Workstation menu bar, choose **VM>Settings>Hardware>Ethernet**). See "Changing a Networking Configuration" on page 282.

Host-Only Networking

Host-only networking creates a network that is completely contained within the host computer. Host-only networking provides a network connection between the virtual machine and the host computer, using a virtual Ethernet adapter that is visible to the host operating system. This approach can be useful if you need to set up an isolated virtual network.

Figure 13-3. Host-Only Networking Setup



How to Set Up Host-Only Networking

A host-only network is set up automatically if you select the Custom setup in the New Virtual Machine wizard and select **Use host-only networking**. On Linux hosts, this selection is available only if you enabled the host-only networking option when you installed Workstation.

Requirements for IP Addresses

If you use host-only networking, your virtual machine and the host virtual adapter are connected to a private Ethernet network. Addresses on this network are provided by the VMware DHCP server.

How to Edit the Setting Later

If you make another selection in the New Virtual Machine wizard and later want to use host-only networking, you can make that change in the virtual machine settings editor (from the Workstation menu bar, choose **VM>Settings>Hardware>Ethernet**). See "Changing a Networking Configuration" on page 282.

Routing and Connection Sharing

If you install the proper routing or proxy software on your host computer, you can establish a connection between the host virtual Ethernet adapter and a physical network adapter on the host computer. This allows you, for example, to connect the virtual machine to a Token Ring or other non-Ethernet network.

On a Windows 2000, Windows XP, or Windows Server 2003 host computer, you can use host-only networking in combination with the Internet connection sharing feature in Windows to allow a virtual machine to use the host's dial-up networking adapter or other connection to the Internet. See your Windows documentation for details on configuring Internet connection sharing.

Example of a Custom Networking Configuration

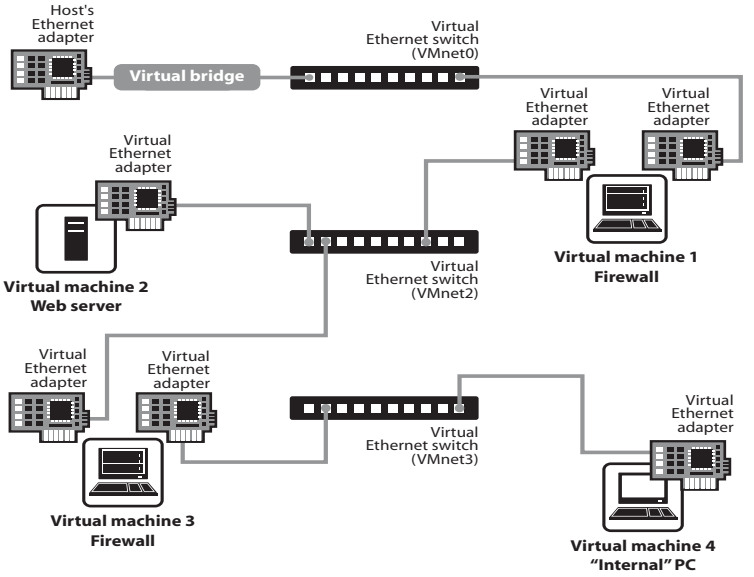
The virtual networking components provided by Workstation make it possible for you to create sophisticated virtual networks. The virtual networks can be connected to one or more external networks, or they can run entirely on the host computer.

Setting up networking components for your custom virtual network is a straightforward process. Before attempting to set up complex virtual networks, you should have a good understanding of how to configure network devices in your host and guest operating systems.

The example described in this section illustrates many of the ways you can combine devices on a virtual network. Other custom configurations are described in "Advanced Networking Topics" on page 289 and "Using NAT" on page 304.

In this configuration, a Web server connects through a firewall to an external network. An administrator's computer connects to the Web server through a second firewall.

Figure 13-4. Custom Configuration That Uses Two Firewalls



To set up this configuration, create four virtual machines and use the virtual machine settings editor to adjust the settings for their virtual Ethernet adapters. You also need to install the appropriate guest operating systems and application software in each virtual machine and make the appropriate networking settings in each virtual machine.

To set up a virtual network that connects to an external network

1 Set up four virtual machines using the New Virtual Machine wizard:

   a To open this wizard, choose **File>New>Virtual Machine**.

   b Create the first virtual machine with bridged networking so it can connect to an external network by using the host computer's Ethernet adapter.

   c Create the other three virtual machines without networking.

   You will set up their virtual Ethernet adapters in later steps.

   You will not install the operating systems until step 7.

2 Configure network settings for the first virtual machine:

   a Open virtual machine 1, but do not power it on.

   b Use the virtual machine settings editor to add a second virtual network adapter.

   See "Adding and Modifying Virtual Network Adapters" on page 282.

   c Connect the second adapter to Custom (VMnet2).

3 Configure network settings for the second virtual machine, as follows:

   a Open virtual machine 2, but do not power it on.

   b Use the virtual machine settings editor to add a virtual network adapter.

   See "Adding and Modifying Virtual Network Adapters" on page 282.

   c Connect the second adapter to Custom (VMnet2).

4 Configure network settings for the third virtual machine, as follows:

   a Open virtual machine 3, but do not power it on.

   b Use the virtual machine settings editor to add a virtual network adapter.

   See "Adding and Modifying Virtual Network Adapters" on page 282.

   c Connect the second adapter to Custom (VMnet2).

   d Use the virtual machine settings editor to add a second virtual network adapter.

   e Connect the adapter to Custom (VMnet3).

5 Configure network settings for the fourth virtual machine, as follows:

   a Open virtual machine 4, but do not power it on.

   b Use the virtual machine settings editor to add a virtual network adapter.

   See "Adding and Modifying Virtual Network Adapters" on page 282.

   c Connect the second adapter to Custom (VMnet3).

6 Determine the network addresses used for VMnet2 and VMnet3:

- On Windows hosts, open a command prompt and run:

  ```
  ipconfig /all
  ```

  Note the network addresses used by each virtual adapter.

- On Linux hosts, open a terminal and run:

  ```
  ifconfig
  ```

  Note the network addresses used by each virtual switch.

7 Power on each virtual machine in turn and install the appropriate guest operating system.

NOTE On a Windows host, for step 8, you are not required to configure network addresses manually. You can instead use Workstation's DHCP server. From the Workstation menu bar, choose **Edit>Virtual Network Settings>DHCP** and add VMnet2 and VMnet3 to the list of virtual networks served by the virtual DHCP server.

---

8 Configure the networking in each guest operating system:

- **Machine 1** – For the bridged Ethernet adapter in virtual machine 1, use the networking settings needed for a connection to the external network. If the virtual machine gets its IP address from a DHCP server on the external network, the default settings should work.

  For the second Ethernet adapter in virtual machine 1, manually assign an IP address in the range you are using with VMnet2.

- **Machine 2** – Assign an IP address in the range you are using with VMnet2.

- **Machine3** – Network adapters are connected to VMnet2 and VMnet3. Assign each adapter an IP address in the range you are using with the virtual network to which it is connected.

- **Machine 4** – Assign an IP address in the range you are using with VMnet3.

9 Install the necessary application software in each virtual machine.

Changing a Networking Configuration

This section describes how you can use the virtual machine settings editor to add virtual Ethernet adapters to your virtual machine and change the configuration of existing adapters.

Adding and Modifying Virtual Network Adapters

This section includes instructions for adding and modifying virtual Ethernet adapters.

To add a new virtual Ethernet adapter

1 Power off the virtual machine to which you want to add the adapter.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, click **Add**.

The Add Hardware wizard starts.

4 Select **Ethernet Adapter** and click **Next**.

5 Select the network type you want to use. If you select **Custom**, choose the VMnet network you want to use from the drop-down list.

NOTE Although VMnet0, VMnet1, and VMnet8 are technically available in this list, they are normally used for bridged, host-only, and NAT configurations, respectively. Special steps are required to make them available for use in custom configurations. You should choose one of the other switches.

---

6 Click **Finish**. The new adapter is added.

7 Click **OK** to save your configuration and close the virtual machine settings editor.

To change the configuration of an existing virtual network adapter

1 Select the virtual machine.

The virtual machine can be either powered on or powered off.

2 From the Workstation menu bar, choose **VM>Settings**.

3 On the **Hardware** tab, select the adapter you want to modify.

4 Select the network type you want to use.

If you select Custom, choose the VMnet virtual network you want to use for the network from the drop-down list.

5 Click **OK** to save your changes and close the virtual machine settings editor.

6 Be sure the guest operating system is configured to use an appropriate IP address on the new network.

If the guest is using DHCP, release and renew the lease. If the IP address is set statically, be sure the guest has an address on the correct virtual network.

Configuring Bridged Networking Options on a Windows Host

On a Windows host, use the virtual network editor to configure bridged networking. (The virtual network editor is not available on a Linux host.) You can:

- View and change the settings for bridged networking on your host. See "To configure VMnet0 bridged networking" on page 283.
- Determine which network adapters on your host to use for bridged networking, as described in "To designate a physical Ethernet adapter to bridge to custom virtual switches" on page 284 and "To add or remove a host Ethernet adapter from the list of excluded adapters" on page 284.
- Map specific network adapters to specific virtual networks, called VMnets, as described in "To make changes to the subnet or the DHCP settings for a virtual network" on page 285.

The changes you make to bridged networking affect all virtual machines using bridged networking on the host.

To configure VMnet0 bridged networking

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

The virtual network editor appears, with the **Summary** tab active.

By default, the VMnet0 virtual network is set up in bridged mode and bridges to one of the active Ethernet adapters on the host computer.

2 Click the **Automatic Bridging** tab, and select the check box for **Automatically choose an available physical adapter**.

On host systems with more than one physical Ethernet adapter installed, the choice of which adapter Workstation uses is arbitrary. If you want to place restrictions on the choice, see the procedure following this one, which is called "To add or remove a host Ethernet adapter from the list of excluded adapters."

3 Click **OK** to save your changes and close the virtual network editor.

The following procedure enables you to exclude a host Ethernet adapter from the list of adapters Workstation uses for automatic bridged networking on VMnet0.

To add or remove a host Ethernet adapter from the list of excluded adapters

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Click the **Automatic Bridging** tab.

3 In the **Excluded adapters** section, do one of the following, as appropriate:

- To remove an adapter, select the adapter and click **Remove**.
- To add an adapter, click **Add**. In the Add Excluded Adapters dialog box, select the listing for the adapter you want to add and click **OK**.

4 Click **OK** to save your changes and close the virtual network editor.

To designate a physical Ethernet adapter to bridge to custom virtual switches

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Click the **Host Virtual Network Mapping** tab.

3 Choose an adapter from the drop-down list beside the name of the virtual switch you want to use.

You can create a custom bridged network on virtual switches VMnet2 to VMnet7. On Windows, you can also use VMnet9. On Linux, you can also use VMnet10 through VMnet255.

CAUTION Be careful when you change the bridged adapter mappings. If you reassign a physical Ethernet adapter to a different virtual network, any virtual machine using the original network loses its network connectivity through that network. You must then change the setting for each affected virtual machine's network adapter individually.

This can be especially troublesome if your host has only one physical Ethernet adapter and you reassign it to a VMnet other than VMnet0. In this case, even though the VMnet still appears to be bridged to an automatically chosen adapter, the only adapter it can use has been assigned to another VMnet.

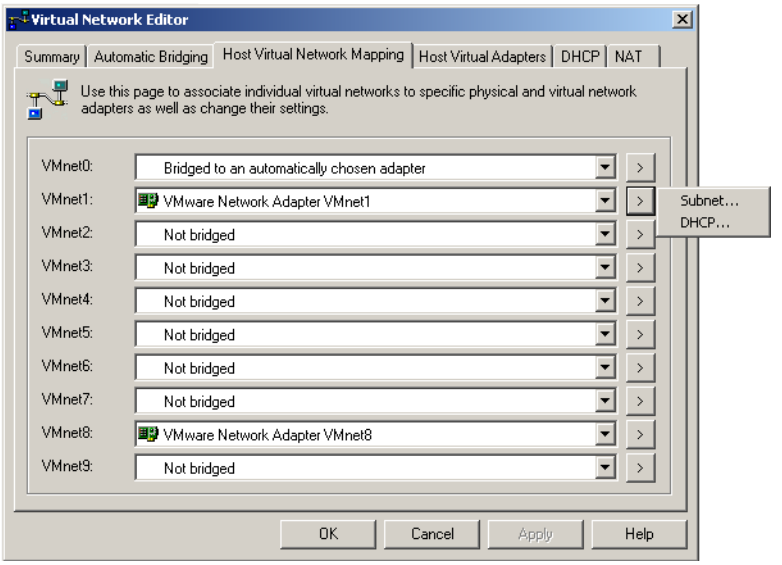
4 Click **OK** to save your changes and close the virtual network editor.

To make changes to the subnet or the DHCP settings for a virtual network

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

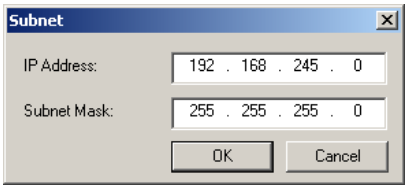
2 Click the **Host Virtual Network Mapping** tab.

3 Click the button on the right that corresponds to the virtual network you want to configure.



4 Choose **Subnet** or **DHCP**:

- In the Subnet dialog box, you can change the subnet's IP address and the subnet mask.



The address should specify a valid network address that is suitable for use with the subnet mask.

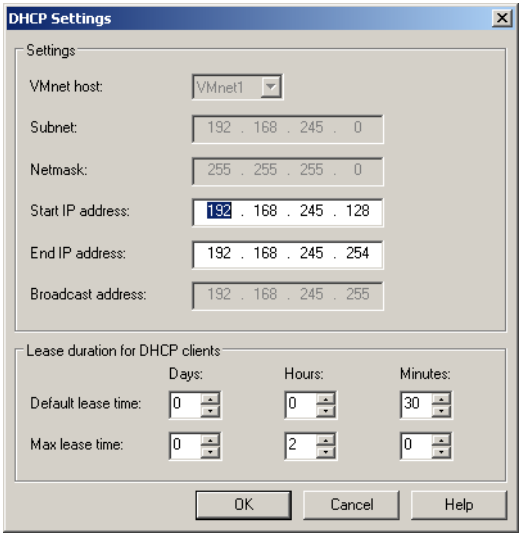
The default subnet mask is 255.255.255.0 (a class-C network). Typically, this means you should modify only the third number in the IP address—for example, x in 192.168.x.0 or 172.16.x.0. In general, you should not change the

subnet mask. Certain virtual network services might not work as well with a customized subnet mask.

When you modify the network address or subnet mask, Workstation automatically updates the IP address settings for other components such as DHCP, NAT, and host virtual adapter if the default settings have never been changed. The specific settings that are automatically updated include DHCP lease range, DHCP server address, NAT gateway address, and host virtual adapter IP address.

However, if you have changed any of these settings from its default value, Workstation does not update that setting automatically. Workstation presumes that custom settings are not to be modified. This is the case even if you later changed the setting back to the default.

- In the DHCP settings dialog box, you can change the range of IP addresses provided by the Workstation DHCP server on a particular virtual network.



You can also use this dialog box to set the duration of DHCP leases provided to clients on the virtual network.

5 Click **OK** to save your changes and close the virtual network editor.

Enabling, Disabling, Adding, and Removing Host Virtual Adapters

When you install Workstation, two network adapters are added to the configuration of your host operating system. One allows the host to connect to the host-only network, and one allows the host to connect to the NAT network.

If you are not using a virtual network adapter, you can remove it. On a Windows host, you can also disable an adapter.

The presence of virtual network adapters has a slight performance cost, because broadcast packets must go to the extra adapters. On Windows networks, browsing your network might be slower than usual. And in some cases, these adapters interact with the host computer's networking configuration in undesirable ways.

To enable or disable a host virtual adapter on a Windows host

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Click the **Host Virtual Adapters** tab.

3 Select the adapter you want to enable or disable.

4 Click **Disable** or **Enable**, as appropriate.

5 Click **OK** to save your changes and close the virtual network editor.

To add or remove a host virtual adapter on a Windows host

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Click the **Host Virtual Adapters** tab.

3 To add an adapter, do the following:

   a Click **Add**.

   b In the Add Network Adapter dialog box, choose the virtual network on which you want to use the adapter and click **OK**.

4 To remove an adapter, select the adapter you want to remove and click **Remove**.

5 Click **OK** to save your changes and close the virtual network editor.

To remove a host virtual adapter from a Linux host

1 In a terminal window, become root (`su –`) and run the Workstation configuration program.

```
vmware-config.pl
```

2 Respond to the following question:

```
Do you want networking for your Virtual Machines? (yes/no/help) [yes]
```

Enter **yes** if you still want to use any networking in your virtual machines, and continue to the next question.

Otherwise, enter **no** to remove all networking.

3 If you enter **yes**, when you receive the following prompt, enter **editor**.

This is the only way to delete virtual network adapters without removing all of them.

```
Would you prefer to modify your existing networking configuration using
the wizard or the editor? (wizard/editor/help) [wizard] editor
```

After you enter **editor**, you will see a list of virtual networks that have been configured.

4 Select the network corresponding to the adapter you want to disable.

```
The following virtual networks have been defined:
. vmnet0 is bridged to eth0
. vmnet1 is a host-only network on subnet 172.16.155.0.
. vmnet8 is NAT network on a private subnet 172.16.107.0.
Which virtual network do you wish to configure? (0-99) 1
```

5 If you receive the a prompt similar to the following, enter **yes**:

```
The network vmnet1 has been reserved for a host-only network. You may
change it, but it is highly recommended that you use it as a host-only
network. Are you sure you want to modify it? (yes/no) [no] yes
```

6 When you receive the a prompt similar to the following, enter **none**, and the virtual network will be removed.

```
What type of virtual network do you wish to set vmnet1?
(bridged,hostonly,nat,none) [hostonly] none
```

Advanced Networking Topics

This section includes the following networking topics:

- "Selecting IP Addresses on a Host-Only Network or NAT Configuration" on page 289
- "Avoiding IP Packet Leakage in a Host-Only Network" on page 291
- "Maintaining and Changing the MAC Address of a Virtual Machine" on page 294
- "Controlling Routing Information for a Host-Only Network on Linux" on page 295
- "Potential Issues with Host-Only Networking on Linux" on page 296
- "Setting Up a Second Bridged Network Interface on a Linux Host" on page 297
- "Setting Up Two Separate Host-Only Networks" on page 298
- "Routing Between Two Host-Only Networks" on page 302
- "Using Virtual Ethernet Adapters in Promiscuous Mode on a Linux Host" on page 303

Selecting IP Addresses on a Host-Only Network or NAT Configuration

The host and all virtual machines configured for host-only networking are connected to the network through a virtual switch. Typically, all the parties on this network use the TCP/IP protocol suite, although other communication protocols can be used.

A network address translation (NAT) configuration also sets up a kind of private network, which must be a TCP/IP network. The virtual machines configured for NAT are connected to that network through a virtual switch. The host computer is also connected to the private network used for NAT by a host virtual adapter.

Each virtual machine and the host must be assigned addresses on the private network. This is typically done using the DHCP server that comes with Workstation. This server does not service virtual (or physical) machines residing on bridged networks.

Addresses can also be assigned statically from a pool of addresses that are not assigned by the DHCP server.

How the Subnet Number Is Assigned

When host-only networking is enabled at the time Workstation is installed, the network number to use for the virtual network is automatically selected as an unused private IP network number. A NAT configuration also uses an unused private network automatically selected when you install Workstation.

To find out which network is used on a Windows host, from the Workstation menu bar, choose **Edit>Virtual Network Settings** and check the subnet number associated with the virtual network (on the **Summary** tab). On a Linux host, run `ifconfig` in a terminal.

Determining Whether to Use DHCP or Statically Assign Addresses

Using DHCP to assign IP addresses is simpler and more automatic than statically assigning them. Most Windows operating systems, for example, come preconfigured to use DHCP at boot time, so Windows virtual machines can connect to the network the first time they are booted, without additional configuration. If you want your virtual machines to communicate with each other using names instead of IP addresses, however, you must set up a naming convention, a name server on the private network, or both. In that case it might be simpler to use static IP addresses.

In general, if you have virtual machines you intend to use frequently or for extended periods of time, it is probably most convenient to assign them static IP addresses or configure the VMware DHCP server to always assign the same IP address to each of these virtual machines.

Configuring the DHCP Server on a Linux Host

On a Linux host, you configure the host-only DHCP server by editing the DHCP configuration file for VMnet1 (`/etc/vmware/vmnet1/dhcp/dhcp.conf`). To configure the DHCP server for the NAT network, edit the configuration file for VMnet8 (`/etc/vmware/vmnet8/dhcp/dhcp.conf`). Be aware, however, that when you configure Workstation by running the `vmware-config.pl` file, all edits made to the `*.dhcp.conf` files are lost.

Editing the DHCP server configuration file requires information that is best obtained directly from the DHCP server documentation. Consult the manual pages `dhcpd(8)` and `dhcpd.conf(8)`.

Configuring the DHCP Server on a Windows Host

On a Windows host, use the virtual network editor to configure the DHCP server.

To configure a DHCP server on Windows

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Click the **DHCP** tab.

3 Select the virtual network for which you want to change settings and click **Properties**.

4 In the DHCP Settings dialog box that appears, make changes and click **OK**.

DHCP Conventions for Assigning IP Addresses

For virtual machines that you do not expect to keep for long, use DHCP and let it allocate an IP address.

For each host-only or NAT network, the available IP addresses are split up using the conventions shown in Table 13-1 and Table 13-2, where <net> is the network number assigned to your host-only or NAT network. Workstation always uses a Class C address for host-only and NAT networks.

Table 13-1. Address Use on a Host-Only Network

Range	Address Use	Example
<net>.1	Host machine	192.168.0.1
<net>.2–<net>.127	Static addresses	192.168.0.2–192.168.0.127
<net>.128–<net>.253	DHCP-assigned	192.168.0.128–192.168.0.253
<net>.254	DHCP server	192.168.0.254
<net>.255	Broadcasting	192.168.0.255

Table 13-2. Address Use on a NAT Network

Range	Address Use	Example
<net>.1	Host machine	192.168.0.1
<net>.2	NAT device	192.168.0.2
<net>.3–<net>.127	Static addresses	192.168.0.3–192.168.0.127
<net>.128–<net>.253	DHCP-assigned	192.168.0.128–192.168.0.253
<net>.254	DHCP server	192.168.0.254
<net>.255	Broadcasting	192.168.0.255

Avoiding IP Packet Leakage in a Host-Only Network

By design, each host-only network should be confined to the host machine on which it is set up. That is, no packets sent by virtual machines on this network should leak out to a physical network attached to the host. Packet leakage can occur only if a machine actively forwards packets. It is possible for the host machine or any virtual machine running on the host-only network to be configured in a way that permits packet leakage.

Windows Hosts

Systems using server versions of Windows operating systems are capable of forwarding IP packets that are not addressed to them. By default, however, these systems and Windows Vista systems come with IP packet forwarding disabled. IP forwarding is not an issue on Windows 2000 Professional, Windows XP Professional, or Windows XP Home Edition hosts.

If you find packets leaking out of a host-only network on a Windows host computer, check to see if forwarding has been enabled on the host machine. If it is enabled, disable it.

To determine whether packet forwarding is enabled and to turn it off

Do one of the following:

- Stop the Routing and Remote Access service, as follows:
  a. Choose **Start>Run**, and then enter **`services.msc`** in the Run dialog box.
  b. In the Services window that appears, disable the Routing and Remote Access service.
- Use Windows Administrative Tools to disable routing and remote access, as follows:
  a. On a Windows 2000 or Windows 2003 Server host, choose **Start>Programs>Administrative Tools>Routing and Remote Access**.

     An icon on the left is labeled with the host name. If a green dot appears over the icon, IP forwarding is turned on.
  b. To turn off IP forwarding, right-click the icon and disable **Routing and Remote Access**.

     A red dot appears, indicating that IP forwarding is disabled.

Windows 2000 Professional Users: The Windows 2000 Administrative Tools are not installed on a Windows 2000 Professional system. However, you can install these tools from a Windows 2000 Server or Windows 2000 Advanced Server CD-ROM.

To install Windows 2000 Administrative Tools on a local computer

1 Open the i386 folder on the applicable Windows 2000 Server disc.

2 Double-click the `adminpak.msi` file, and follow the instructions that appear in the Windows 2000 Administrative Tools Setup wizard.

3 After Windows 2000 Administrative Tools are installed, you can access most of the server administrative tools by choosing **Start>Programs>Administrative Tools**.

Linux Hosts

If you find packets leaking out of a host-only network on a Linux host computer, see whether forwarding has mistakenly been enabled on the host machine. If it is enabled, disable it.

To determine whether packet forwarding is enabled

Depending on which type of Linux system you have, use one of the following methods:

- Disable forwarding by writing a 0 (zero) to the special file `/proc/sys/net/ipv4/ip_forward`. As root (`su–`), enter this command:

  ```
  echo "0" > /proc/sys/net/ipv4/ip_forward
  ```

- Use a configuration option that is appropriate for your Linux distribution. For example, you might use a control panel, specify a setting at the time you compile your kernel, or possibly enter a specification when you boot your system. Consult your operating system documentation for details on the method to use with your particular distribution.

Using Filtering

If the host computer has multiple network adapters, it might be intentionally configured to do IP forwarding. If that is the case, you do not want to disable forwarding. To avoid packet leakage, you must enable a packet filtering facility and specify that packets from the host-only network should not be sent outside the host computer. Consult your operating system documentation for details on how to configure packet filtering.

Leaks from a Virtual Machine

Virtual machines might leak packets, as well. For example, if you use dial-up networking support in a virtual machine and packet forwarding is enabled, host-only network traffic might leak out through the dial-up connection.

To prevent the leakage, be sure packet forwarding is disabled in your guest operating system.

Maintaining and Changing the MAC Address of a Virtual Machine

When a virtual machine is powered on, Workstation assigns each of its virtual network adapters an Ethernet MAC (media access control) address. A MAC address is the unique address assigned to each Ethernet network device.

The software guarantees that virtual machines are assigned unique MAC addresses within a given host system. The virtual machine is assigned the same MAC address every time it is powered on if both of the following conditions are true:

- The virtual machine is not moved. That is, the path name and filename for the virtual machine's configuration file remain the same.
- No changes are made to certain settings in the configuration file.

In addition, Workstation does its best, but cannot guarantee, to automatically assign unique MAC addresses for virtual machines that run on multiple host systems.

Avoiding MAC Changes

To avoid changes in the MAC address automatically assigned to a virtual machine, do not move the virtual machine's configuration file. Moving it to a different host computer or even moving it to a different location on the same host computer changes the MAC address.

Also do not change certain settings in the virtual machine's configuration (`.vmx`) file. If you never edit the configuration file by hand and do not remove the virtual Ethernet adapter, these settings remain unchanged. If you do edit the configuration file by hand, do not remove or change the following options:

```
ethernet[n].generatedAddress
ethernet[n].addressType
ethernet[n].generatedAddressOffset
uuid.location
uuid.bios
ethernet[n].present
```

In these options, [n] is the number of the virtual Ethernet adapter, for example `0`.

NOTE To preserve a virtual Ethernet adapter's MAC address, you also must be careful not to remove the adapter. If you remove the adapter but later re-create it, the adapter might receive a different MAC address.

Manually Assigning a MAC Address

To guarantee that the same MAC address is assigned to a given virtual machine every time you power it on, even if the virtual machine is moved, or if you want to guarantee a unique MAC address for each virtual machine within a networked environment, you can assign the address manually instead of allowing Workstation to assign it.

To assign the same unique MAC address to any virtual machine manually, use a text editor to remove three lines from the configuration file and add one line. The configuration file has a `.vmx` extension at the end of the filename. On a Linux host, a virtual machine created with an earlier VMware product might have a configuration file with a `.cfg` extension.

Remove the three lines that begin with the following from the configuration file:

```
ethernet[n].generatedAddress
ethernet[n].addressType
ethernet[n].generatedAddressOffset
```

In these options, [n] is the number of the virtual Ethernet adapter, for example, ethernet0.

Add the following line to the configuration file:

```
ethernet[n].address = 00:50:56:XX:YY:ZZ
```

In this line, the fourth pair of numbers, `XX`, must be a valid hexadecimal number between `00h` and `3Fh`, and `YY` and `ZZ` must be valid hexadecimal numbers between `00h` and `FFh`. Because Workstation virtual machines do not support arbitrary MAC addresses, you must use the above format. Place this line above the UUID lines in the file.

If you choose a value for `XX:YY:ZZ` that is unique among your hard-coded addresses, conflicts between the automatically assigned MAC addresses and the manually assigned addresses should never occur.

Controlling Routing Information for a Host-Only Network on Linux

A host-only network is a full-fledged network. It has a network interface associated with it (VMnet1) that is marked “up” at the time the host operating system is booted. Consequently, routing server processes that operate on the host operating system, such as `routed` and `gated`, automatically discover it and propagate information on how to reach it unless you explicitly configure them not to do so.

If either of these programs is being run only to receive routing information, the easiest solution is to run it with a `-q` option so that it does not supply routing information but only receives it.

If, however, routing services are running because they are to supply routing information, you need to configure them so they do not advertise routes to the host-only network.

The version of `routed` that comes with many distributions of Linux has no support for specifying that an interface should not be advertised. Consult the `routed(8)` manual page for your system in case you have a more contemporary version of the software.

For `gated`, configuration is involved. You need to explicitly exclude the VMnet1 interface from any protocol activity. If you need to run virtual machines on a host-only network on a multihomed system where `gated` is used and have problems doing so, please contact VMware technical support by submitting a support request at www.vmware.com/requestsupport.

Potential Issues with Host-Only Networking on Linux

The following are common issues you might encounter when you are configuring a host-only network.

DHCPD on the Linux Host Does Not Work After Installing Workstation

If you were running the DHCP server program `dhcpd` on your machine before installing Workstation, it probably was configured to respond to DHCP requests from clients on any network interface present on the machine. When host-only networking is configured, an additional network interface, VMnet1, is marked "up" and available for use, and `dhcpd` might notice this.

In such cases, some `dhcpd` implementations abort if their configuration files do not include a subnet specification for the interface—even if `dhcpd` is not supposed to respond to messages that arrive through the interface.

The best solution is to add a line in the following format to the `dhcpd` configuration file:

```
subnet <net>.0 netmask 255.255.255.0 {}
```

`<net>` is the network number assigned to your host-only network—for example, 192.168.0. This line in the configuration file informs `dhcpd` about the host-only network and tells it explicitly not to respond to any DHCP requests it sees coming from it.

An alternative solution is to explicitly state the set of network interfaces that you want `dhcpd` to listen to each time you start the program. For example, if your machine has one Ethernet interface, `eth0`, each time you start `dhcpd`, list it on the command line:

```
dhcpd eth0
```

This keeps `dhcpd` from probing for all available network interfaces.

If these solutions do not work for your DHCP server program, it is probably an old DHCP server. You can try upgrading to a more current version such as the DHCP software available from the ISC (www.isc.org).

DHCP and Dynamic Domain Name Service (DDNS)

Use DHCP to supply IP addresses as well as other information, such as the identity of a host running a name server and the nearest router or gateway. The DHCP server in Workstation does not provide a means to dynamically establish a relationship between the IP address it assigns and a client's name (that is, to update a DNS server using DDNS).

To use names to communicate with other virtual machines you must either edit the DHCP configuration file for VMnet1 (`/etc/vmware/vmnet1/dhcpd/dhcpd.conf`) or use IP addresses that are statically bound to a host name. Editing the DHCP server configuration file requires information that is best obtained directly from the DHCP server documentation. Consult the manual pages `dhcpd(8)` and `dhcpd.conf(8)`. Also be aware that edits to this file are lost the next time you configure Workstation by running the `vmware-config.pl` file.

Setting Up a Second Bridged Network Interface on a Linux Host

If you have two Ethernet adapters installed on your host computer, connected to two different networks, you might want your virtual machines on that host computer to bridge to both Ethernet adapters so the virtual machines can access either or both physical networks.

When you install Workstation on a host computer with multiple Ethernet adapters, you can configure more than one bridged network. You can also configure additional bridged networks at any time by rerunning `vmware-config.pl`.

To bridge networks by running vmware-config.pl

1 On the host computer, become root (`su -`) and run the Workstation configuration program:

```
vmware-config.pl
```

2 If you have more than one physical Ethernet adapter, enter **`yes`** at the following prompt:

```
The following bridged networks have been defined:
. vmnet0 is bridged to eth0
Do you wish to configure another bridged network? (yes/no) [no]
```

If you have additional physical Ethernet adapters not yet connected to a bridged network, the prompt is repeated, showing information about all currently configured bridged networks.

3 When you have set up all the bridged networks you want, enter **no**.

Setting Up Two Separate Host-Only Networks

For some configurations, you might need to set up more than one host-only network on the same host computer. You might, for example, want to have two virtual machines connected to one host-only network, and at the same time have other virtual machines connected to another host-only network so the network traffic on each network is isolated.

Or you might want to test routing between two virtual networks. Or you might want to test a virtual machine with multiple network interface cards, without using any physical Ethernet adapters.

On Windows hosts, the first host-only network is set up automatically when you install Workstation.

On Linux hosts, the first host-only network is set up when you run the `vmware-config.pl` program after you install Workstation, provided you agree to install host-only networking. If you did not agree to use host-only networking, you need to run the program again to set up host-only networking. For instructions, see "Configuring Workstation with vmware-config.pl" on page 51.

Adding a Second Host-Only Network

To set up the second host-only network, use one of the following procedures.

To set up the second host-only interface on a Windows host

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 On the **Host Virtual Adapters** tab, click **Add**.

3 Choose the virtual network on which you want to use the adapter and click **OK**.

4 Click **OK** to close the virtual network editor.

To set up the second host-only interface on a Linux host

1 As root (`su -`), run the Workstation configuration program:

```
/usr/bin/vmware-config.pl
```

2 When you see the following prompt, enter **`yes`**:

```
Do you want to be able to use host-only networking in your virtual
machines?
```

The wizard reports on host-only networks that you have already set up on the host or, if none is present, configures the first host-only network.

3 When you see the following prompt, enter **`yes`**:

```
Do you wish to configure another host-only network?
```

Repeat this step until you have as many host-only networks as you want, and then enter **`no`**.

4 Complete the remaining steps in the wizard. When it is finished, it restarts all services used by Workstation.

5 Run `ifconfig`.

At least four network interfaces appear: eth0, lo, vmnet1, and vmnet2. If the VMnet interfaces do not show up immediately, wait for a minute, and run the command again. These four interfaces should have different IP addresses on separate subnets.

Configuring the Virtual Machines

Now you have two host-only interfaces (VMnet1 and VMnet2). You are ready to set up your virtual machines for one of the following configurations:

- **Configuration 1** – The virtual machine is configured with one virtual Ethernet adapter, and that virtual adapter is connected to the default host-only interface (VMnet 1). To use this configuration, see "To use configuration 1 or 2" on page 300.
- **Configuration 2** – The virtual machine is configured with one virtual Ethernet adapter, and that virtual adapter is connected to the newly created host-only interface (VMnet2). To use this configuration, see "To use configuration 1 or 2" on page 300.
- **Configuration 3** – The virtual machine is configured with two virtual Ethernet adapters. One virtual adapter is connected to the default host-only interface (VMnet1) and the other virtual adapter is connected to the newly created host-only interface (VMnet2). To use this configuration, see "To use configuration 3 – connect to two host-only interfaces" on page 301.

To use configuration 1 or 2

1. Select the virtual machine.

   It can be either powered off or powered on.

2. From the Workstation menu bar, choose **VM>Settings**.

   The virtual machine settings editor opens.

3. On the **Hardware** tab, select **Ethernet**.

4. In the **Network Connection** section, do one of the following:

   - To connect to the default host-only interface (VMnet1), select **Host-only**.
   - To connect to the newly created host-only interface, select **Custom**, and choose **VMnet2 (Host-only)** from the drop-down list on the right.

   If no network adapter is shown in the list of devices, add one, as described in "Adding and Modifying Virtual Network Adapters" on page 282.

To use configuration 3 – connect to two host-only interfaces

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 From the Workstation menu bar, choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, select **Ethernet**.

4 Connect the two adapters, as follows:

a Select the first network adapter in the list of devices, and in the **Network Connection** section, select **Host-only**.

This adapter is connected to the default host-only interface (VMnet1),

b Select the second network adapter in the list, and in the **Network Connection** section, select **Custom** and choose **VMnet2 (Host-only)** from the drop-down list.

If no network adapter is shown in the list of devices, add one, as described in "Adding and Modifying Virtual Network Adapters" on page 282.

To finish configuring the adapters

1 Power on the virtual machine and install your guest operating system.

In configurations 1 and 2, you see one Ethernet adapter. In configuration 3, you see two Ethernet adapters within the guest.

2 Configure the Ethernet adapters as you would physical adapters on a physical computer, giving each an IP address on the appropriate VMnet subnet.

To see what IP address a host-only network is using:

- On Windows hosts, open a command prompt and run:

```
ipconfig /all
```

- On Linux hosts, open a terminal and run:

```
ifconfig
```

Routing Between Two Host-Only Networks

If you are setting up a complex test network that uses virtual machines, you might want to have two independent host-only networks with a router between them.

There are two basic approaches. In one, the router software runs on the host computer. In the other, the router software runs in its own virtual machine. In both cases, you need two host-only interfaces.

The examples described here outline the simplest case, with one virtual machine on each of the host-only networks. For more complex configurations, you can add more virtual machines and host-only networks, as appropriate.

To set up routing between two host-only networks

1 Set up the connection to the first (default) host-only interface, as described in "To use configuration 1 or 2" on page 300.

2 Set up the connection to the second (VMnet2) host-only interface, as described in "To use configuration 1 or 2" on page 300.

3 If you plan to run the router software on a virtual machine, set up a third virtual machine with connections to the two host only interfaces, as described in "To use configuration 3 – connect to two host-only interfaces" on page 301.

   To run the router software on your host computer, skip this step.

   The rest of the steps in this procedure describe how to configure the virtual machines to use static IP addresses.

4 Stop the VMnet DHCP server service:

   - On a Windows host, from the Workstation menu bar, choose **Edit>Virtual Network Settings>DHCP**, select the service and click **Stop**.
   - On a Linux host, open a terminal and use the following command to stop the `vmnet-dhcpd` service:

     ```
     killall -TERM vmnet-dhcpd
     ```

5 Install guest operating systems in each of the virtual machines.

6 Install the router software, either on the host computer or in the third virtual machine, depending on the approach you are using.

7 Configure networking in the first two virtual machines to use addresses on the appropriate host-only network:

- On Windows hosts, open a command prompt and run `ipconfig /all` to see which IP addresses each host-only network is using.
- On Linux hosts, open a terminal and run `ifconfig` to see which IP addresses each host-only network is using.

8 Assign IP addresses by doing one of the following:

- If you are running the router on the host computer, assign default router addresses based on the addresses of the host-only adapters on the host computer.

  In the first virtual machine's networking configuration, the default router address should be the IP address for the host-only adapter connected to VMnet1. In the second virtual machine's networking configuration, the default router address should be the IP address for the host-only adapter connected to VMnet2.

- If you are running the router software in a third virtual machine, set the default router addresses in the first two virtual machines based on those used by the third virtual machine.

  In the first virtual machine's networking configuration, the default router address should be the IP address for the third virtual machine's Ethernet adapter connected to VMnet1. In the second virtual machine's networking configuration, the default router address should be the IP address for the third virtual machine's Ethernet adapter connected to VMnet2.

At this point you should be able to ping the router machine from virtual machines 1 and 2. If the router software is set up correctly, you should be able to communicate between the first and second virtual machines.

Using Virtual Ethernet Adapters in Promiscuous Mode on a Linux Host

Workstation does not allow the virtual Ethernet adapter to go into promiscuous mode unless the user running Workstation has permission to make that setting. This follows the standard Linux practice that only root can put a network interface into promiscuous mode.

When you install and configure Workstation, you must run the installation as root. Workstation creates the VMnet devices with root ownership and root group ownership, which means that only root has read and write permissions to the devices.

To set the virtual machine's Ethernet adapter to promiscuous mode, you must launch Workstation as root because you must have read and write access to the VMnet device. For example, if you are using bridged networking, you must have access to `/dev/vmnet0`.

To grant selected other users read and write access to the VMnet device, you can create a new group, add the appropriate users to the group and grant that group read and write access to the appropriate device. You must make these changes on the host operating system as root (`su –`). For example, you can enter the following commands:

```
chgrp <newgroup> /dev/vmnet0
chmod g+rw /dev/vmnet0
```

`<newgroup>` is the group that should have the ability to set vmnet0 to promiscuous mode.

For all users to be able to set the virtual Ethernet adapter (`/dev/vmnet0` in the example) to promiscuous mode, run the following command on the host operating system as root:

```
chmod a+rw /dev/vmnet0
```

Using NAT

Network address translation (NAT) provides a way for virtual machines to use most client applications over almost any type of network connection available to the host. The only requirement is that the network connection must support TCP/IP.

NAT is useful when you have a limited supply of IP addresses or are connected to the network through a non-Ethernet network adapter. NAT works by translating addresses of virtual machines in a private VMnet network to that of the host machine. When a virtual machine sends a request to access a network resource, it appears to the network resource as if the request is coming from the host machine.

How the NAT Device Uses the VMnet8 Virtual Switch

The NAT device is connected to the VMnet8 virtual switch. Virtual machines connected to the NAT network also use the VMnet8 virtual switch.

The NAT device waits for packets coming from virtual machines on the VMnet8 virtual network. When a packet arrives, the NAT device translates the address of the virtual machine to that of the host before forwarding the packet to the external network. When data arrives from the external network for the virtual machine on the private network, the NAT device receives the data, replaces the network address with that of the virtual

machine and forwards the data to the virtual machine on the virtual network. This translation occurs automatically and requires minimal configuration on the guest and the host.

The Host Computer and the NAT Network

The host computer has a host virtual adapter on the NAT network (identical to the host virtual adapter on the host-only network). This adapter allows the host and the virtual machines to communicate with each other for such purposes as file sharing. The NAT device never forwards traffic from the host virtual adapter.

DHCP on the NAT Network

To make networking configuration easy, a DHCP server is installed when you install Workstation. Virtual machines running on the network with the NAT device can dynamically obtain their IP addresses by sending out DHCP requests.

The DHCP server on the NAT network, which is also used in host-only networking configurations, dynamically allocates IP addresses in the range of <net>.128 through <net>.254, where <net> is the network number assigned to your NAT network. Workstation always uses a Class C address for NAT networks. IP addresses <net>.3 through <net>.127 can be used for static IP addresses. IP address <net>.1 is reserved for the host adapter; <net>.2 is reserved for the NAT device. For more information, see "DHCP Conventions for Assigning IP Addresses" on page 291.

In addition to the IP address, the DHCP server on the NAT network sends out configuration information that enables the virtual machine to operate. This information includes the default gateway and the DNS server. In the DHCP response, the NAT device instructs the virtual machine to use the IP address <net>.2 as the default gateway and DNS server. This causes all IP packets destined for the external network and DNS requests to be forwarded to the NAT device.

DNS on the NAT Network

The NAT device acts as a DNS server for the virtual machines on the NAT network. Actually, the NAT device is a DNS proxy and merely forwards DNS requests from the virtual machines to a DNS server that is known by the host. Responses come back to the NAT device, which then forwards them to the virtual machines.

If they get their configuration information from DHCP, the virtual machines on the NAT network automatically use the NAT device as the DNS server. However, the virtual machines can be statically configured to use another DNS server.

The virtual machines in the private NAT network are not, themselves, accessible through DNS. If you want the virtual machines running on the NAT network to access each other by DNS names, you must set up a private DNS server connected to the NAT network.

External Access from the NAT Network

In general, any protocol using TCP or UDP can be used automatically by a virtual machine on the NAT network as long as the virtual machine initiates the network connection. This is true for most client applications such as Web browsing, Telnet, passive-mode FTP, and downloading streaming video. Additional protocol support has been built into the NAT device to allow FTP and ICMP echo (ping) to work transparently through the NAT.

On the external network to which the host is connected, any virtual machine on the NAT network appears to be the host itself, because its network traffic uses the host's IP address. It is able to send and receive data using TCP/IP to any machine that is accessible from the host.

Before any communication can occur, the NAT device must set up a mapping between the virtual machine's address on the private NAT network and the host's network address on the external network.

When a virtual machine initiates a network connection with another network resource, this mapping is created automatically. The operation is transparent to the user of the virtual machine on the NAT network. No additional work needs to be done.

The same cannot be said for network connections that are initiated from the external network to a virtual machine on the NAT network. When a machine on the external network attempts to initiate a connection with a virtual machine on the NAT network, it cannot reach the virtual machine because the NAT device does not forward the request. Network connections that are initiated from outside the NAT network are not transparent.

However, it is possible to configure port forwarding manually on the NAT device so network traffic destined for a certain port can still be forwarded automatically to a virtual machine on the NAT network. See "Advanced NAT Configuration" on page 307.

File sharing of the type used by Windows operating systems and Samba is possible among computers on the NAT network, including virtual machines and the host computer. If you are using WINS servers on your network, a virtual machine using NAT networking can access shared files and folders on the host that are known by the WINS server so long as those shared files and folders are in the same workgroup or domain.

Advanced NAT Configuration

This section includes the following sections:

- "On a Windows Host" on page 307
- "On a Linux Host" on page 309

On a Windows Host

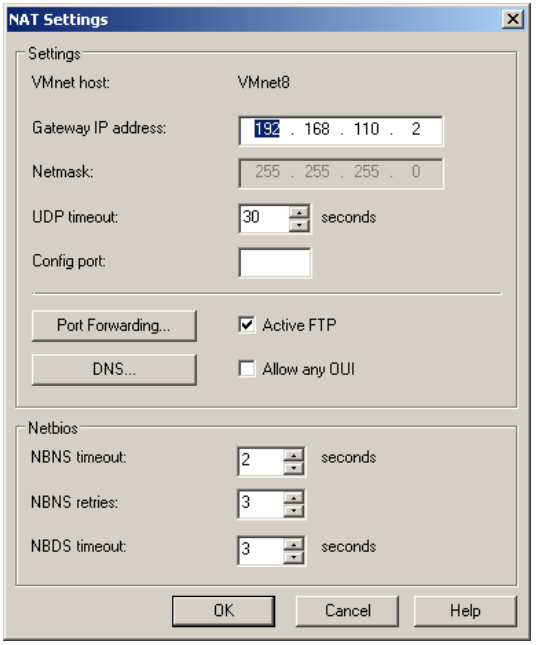
Use the virtual network settings editor to configure NAT, as described in the following procedure. To edit the NAT configuration file, see "Custom NAT and DHCP Configuration on a Windows Host" on page 308.

To configure NAT on a Windows host

1 From the Workstation menu bar, choose **Edit>Virtual Network Settings**.

2 Use the controls on the **NAT** tab to configure NAT:

- Stop and start the virtual NAT device by clicking the appropriate buttons.
- To edit NAT settings for a virtual network, choose the VMnet network from the drop-down menu and click **Edit**. The NAT Settings dialog box appears.



3 Click the appropriate button to set up or change port forwarding or to specify DNS servers the virtual NAT device should use.

4 Click **OK** to close the virtual network editor.

Custom NAT and DHCP Configuration on a Windows Host

If you are an advanced user on a Windows host computer, you can make custom configuration settings by editing the NAT and DHCP configuration files. If your host operating system is installed on the C drive, the configuration files for NAT and DHCP are in the following locations:

- **NAT:** `C:\Documents and Settings\All Users\Application Data\VMware\vmnetnat.conf`

  For more information about this file, see "Contents of the NAT Configuration File" on page 309.

- **DHCP:** `C:\Documents and Settings\All Users\Application Data\VMware\vmnetdhcp.conf`

NOTE You can change many key NAT and DCHP settings using the virtual network settings editor (**Edit>Virtual Network Settings**). However, if you make manual changes to the configuration files, those changes might be lost when you use the virtual network settings editor. If you make manual changes, make backup copies of the files before changing any settings in the virtual network settings editor. You can then copy your manual changes back into the appropriate configuration files.

Specifying Connections from Ports Below 1024

When a client machine makes a TCP or UDP connection to a server, the connection comes from a particular port on the client (the source port) and connects to a particular port on the server (the destination port). For security reasons, some servers accept connections only from source ports below 1024. You might see this configuration on machines used as NFS file servers, for example.

If a virtual machine using NAT attempts to connect to a server that requires the client to use a source port below 1024, it is important that the NAT device forward the request from a port below 1024. You can specify this behavior in the `vmnetnat.conf` file.

This behavior is controlled by entries in sections headed `[privilegedUDP]` and `[privilegedTCP]`. You might need to add settings to or modify settings in either or both of these sections, depending on the kind of connection you need to make.

You can set two parameters, each of which appears on a separate line.

```
autodetect = <n>
```

The autodetect setting determines whether the VMware NAT device automatically attempts to map virtual machine source ports below 1024 to NAT source ports below 1024. A setting of `1` means true. A setting of `0` means false. On a Windows host, the default is `1` (true). On a Linux host, the default is `0` (false).

```
port = <n>
```

The port setting specifies a destination port (where `<n>` is the port on the server that accepts the connection from the client). Whenever a virtual machine connects to the specified port on any server, the NAT device attempts to make the connection from a source port below 1024. You can include one or more port settings in the `[privilegedUDP]` or `[privilegedTCP]` section or in both sections, as required for the connections you need to make. Enter each port setting on a separate line.

On a Linux Host

Use the NAT configuration file on the host to configure the NAT device. This file is located in `/etc/vmware/vmnet8/nat/nat.conf`.

The configuration file is divided into sections. Each section configures a part of the NAT device. Text surrounded by square brackets—such as `[host]`—marks the beginning of a section. In each section is a configuration parameter that can be set. The configuration parameters take the form `ip = 192.168.27.2/24`.

For an example of a NAT configuration file, see "Sample Linux vmnetnat.conf File" on page 315. The configuration file variables are described in "Contents of the NAT Configuration File" on page 309.

Contents of the NAT Configuration File

The NAT configuration file is located in:

- On a Windows host:

  ```
  C:\Documents and Settings\All Users\Application Data\VMware\vmnetnat.conf
  ```

  If you edit this file and then use the virtual network settings editor (**Edit>Virtual Network Settings**), your edits might be lost.

- On a Linux host:

  ```
  /etc/vmware/vmnet8/nat/nat.conf
  ```

The NAT configuration file contains the following sections.

The [host] Section

`ip`

The IP address that the NAT device should use. It can optionally be followed by a slash and the number of bits in the subnet.

`netmask`

The subnet mask to use for the NAT network. DHCP addresses are allocated from this range of addresses.

`configport`

A port that can be used to access status information about the NAT device.

`device`

The VMnet device to use. Windows devices are of the form `VMnet<x>` where `<x>` is the number of the VMnet. Linux devices are of the form `/dev/vmnet<x>`.

`activeFTP`

Flag to indicate if active FTP is to be allowed. Active FTP allows incoming connections to be opened by the remote FTP server. Turning this off means that only passive mode FTP works. Set this flag to `0` to turn it off.

The [udp] Section

`timeout`

Number of seconds to keep the UDP mapping for the NAT network.

The [dns] Section

This section is for Windows hosts only. Linux does not use this section.

`policy`

Policy to use for DNS forwarding. Accepted values include:

- `order` – Send one DNS request at a time in order of the name servers.
- `rotate` – Send one DNS request at a time and rotate through the DNS servers.
- `burst` – Send to three servers and wait for the first one to respond.

`timeout`

Time in seconds before retrying a DNS request.

`retries`

Number of retries before the NAT device gives up on a DNS request.

`autodetect`

Flag to indicate whether the NAT device should detect the DNS servers available to the host.

`nameserver1`

IP address of a DNS server to use.

`nameserver2`

IP address of a DNS server to use.

`nameserver3`

IP address of a DNS server to use.

If autodetect is on and some name servers are specified, the DNS servers specified in `nameserver1`, `nameserver2` and `nameserver3` are added before the list of detected DNS servers.

The [netbios] Section

This section applies to Windows hosts only. Linux does not use this section.

`nbnsTimeout = 2`

Timeout, in seconds, for NBNS queries.

`nbnsRetries = 3`

Number of retries for each NBNS query.

`nbdsTimeout = 3`

Timeout, in seconds, for NBDS queries.

The [incomingtcp] Section

Use this section to configure TCP port forwarding for NAT. In this section, you can assign a port number to an IP address and port number on a virtual machine.

The following line shows the format used in this section:

```
8887 = 192.168.27.128:21
```

This example creates a mapping from port 8887 on the host to the IP address 192.168.27.128 and port 21. When this mapping is set and an external machine connects to the host at port 8887, the network packets are forwarded to port 21 (the standard port for FTP) on the virtual machine with IP address 192.168.27.128.

The [incomingudp] Section

Use this section to configure UDP port forwarding for NAT. In this section, you can assign a port number to an IP address and port number on a virtual machine.

The following line shows the format used in this section. It illustrates a way to forward X server traffic from the host port 6000 to the virtual machine's port 6001:

```
6000 = 192.168.27.128:6001
```

This example creates a mapping from port 6000 on the host to the IP address 192.168.27.128 and port 6001. When this mapping is set and an external machine connects to the host at port 6000, the network packets are forwarded to port 6001 on the virtual machine with IP address 192.168.27.128.

Considerations for Using NAT

Following are the considerations to take into account when you use NAT:

- NAT causes some performance loss.

  Because NAT requires that every packet sent to and received from a virtual machine must be in the NAT network, there is an unavoidable performance penalty.

- NAT is not perfectly transparent.

  It does not normally allow connections to be initiated from outside the network, although you can set up server connections by manually configuring the NAT device. The practical result is that some TCP and UDP protocols that require a connection be initiated from the server machine—some peer to peer applications, for example—do not work automatically, and some might not work at all.

- NAT provides some firewall protection.

  A standard NAT configuration provides basic-level firewall protection because the NAT device can initiate connections from the private NAT network, but devices on the external network cannot normally initiate connections to the private NAT network.

Using NAT with NetLogon

When using NAT networking in a virtual machine with a Windows guest operating system running on a Windows host, you can use NetLogon to log on to a Windows domain from the virtual machine. You can then access file shares known by the WINS server in the domain.

To use NetLogon, you need to know how WINS servers and Windows domain controllers work. This section explains how to set up the virtual machine to use NetLogon. The setup process is similar to the way you set up a physical computer on one LAN that is using a domain controller on another LAN.

To log on to a Windows domain outside the virtual NAT network, the virtual machine needs access to a WINS server for that domain. You can connect the virtual machine to a WINS server in two ways:

- Connect to the WINS server provided by the DHCP server used on the NAT network, if the WINS server is already set up on the host.
- To connect from the virtual machine to a WINS server not set up on the host, you can manually enter the IP address of the WINS server.

This section provides instructions for both strategies.

Using NAT to Connect to an Existing WINS Server Set Up on the Host

In order to use this method, a WINS server in the same workgroup or domain must be set up on the host. These steps use Windows 2000, Windows XP, or Windows 2003 Server as a guide. The process is similar for Windows NT, Windows Me, and Windows 9x guests. For Windows Vista, the first couple of steps are different, as noted in the specific steps below.

To use NAT to connect to a WINS server on the host

1 In the virtual machine, right-click **My Network Places** and choose **Properties**.

For Windows Vista, open the Network and Sharing Center, and click the **View Status** link for the connection that uses the desired virtual network adapter.

2 In the Network Connections window, right-click the virtual network adapter and choose **Properties**.

For Windows Vista, in the Connection Status window, click **Properties** and click **Continue** when prompted for permission.

3 In the Properties dialog box, select **Internet Protocol (TCP/IP)** and click **Properties**.

4 In the TCP/IP Properties dialog box, click **Advanced**.

5 On the **WINS** tab, under **NetBIOS** setting, select **Use NetBIOS setting from DHCP Server**.

6 Click **OK** twice and click **Close**.

Manually Entering the IP Address of a WINS Server

Use this method to connect to a WINS server in the same workgroup or domain that is not already set up on the host.

To manually enter the IP address of a WINS server

1 In the virtual machine, right-click **My Network Places** and choose **Properties**.

For Windows Vista, open the Network and Sharing Center, and click the **View Status** link for the connection that uses the virtual network adapter.

2 In the Network Connections window, right-click the virtual network adapter and choose **Properties**.

For Windows Vista, in the Connection Status window, click **Properties** and click **Continue** when prompted for permission.

3 In the Properties dialog box, select **Internet Protocol (TCP/IP)** and click **Properties**.

4 In the TCP/IP Properties dialog box, click **Advanced**.

5 On the **WINS** tab, click **Add**.

6 In the TCP/IP WINS Server dialog box, enter the IP address for the WINS server in the WINS server field and click **OK**.

The IP address of the WINS server appears in the WINS addresses list on the WINS tab.

7 Repeat Step 5 and Step 6 for each WINS server to which you want to connect from this virtual machine.

8 Click **OK** twice and click **Close**.

Now that the virtual machine has an IP address for a WINS server, you use NetLogon in the virtual machine to log on to a domain and access shares in that domain.

For example, if the WINS server covers a domain with a domain controller, it is possible to access that domain controller from the virtual machine and add the virtual machine to the domain. You need to know the user ID and password of the Administrator user on the domain controller.

NOTE Your access is limited to shares of virtual machines that are on the same NAT network or are bridged on the same domain.

Sample Linux vmnetnat.conf File

```
# Linux NAT configuration file

[host]

# NAT gateway address
ip = 192.168.237.2/24
hostMAC = 00:50:56:C0:00:08

# enable configuration; disabled by default for security reasons
#configport = 33445

# VMnet device if not specified on command line
device = VMnet8

# Allow PORT/EPRT FTP commands (they need incoming TCP stream...)
activeFTP = 1

# Allows the source to have any OUI. Turn this one if you change the OUI
# in the MAC address of your virtual machines.
#allowAnyOUI = 1

[udp]
# Timeout in seconds, 0 = no timeout, default = 60; real value might
# be up to 100% longer
timeout = 30

[dns]
# This section applies only to Windows.
#
# Policy to use for DNS forwarding. Accepted values include order,
# rotate, burst.
#
# order: send one DNS request at a time in order of the name servers
# rotate: send one DNS request at a time, rotate through the DNS servers
# burst: send to three servers and wait for the first one to respond
policy = order;

# Timeout in seconds before retrying DNS request.
timeout = 2

# Retries before giving up on DNS request
retries = 3

# Automatically detect the DNS servers (not supported in Windows NT)
autodetect = 1

# List of DNS servers to use. Up to three may be specified
#nameserver1 = 208.23.14.2
```

```
#nameserver2 = 63.93.12.3
#nameserver3 = 208.23.14.4

[netbios]
# This section applies only to Windows.

# Timeout for NBNS queries.
nbnsTimeout = 2

# Number of retries for each NBNS query.
nbnsRetries = 3

# Timeout for NBDS queries.
nbdsTimeout = 3

[incomingtcp]
# Use these with care - anyone can enter into your virtual machine through
# these...

# FTP (both active and passive FTP is always enabled)
#   ftp localhost 8887
#8887 = 192.168.27.128:21

# WEB (make sure that if you are using named webhosting, names point to
#   your host, not to guest... And if you are forwarding port other
#   than 80 make sure that your server copes with mismatched port
#   number in Host: header)
#   lynx http://localhost:8888
#8888 = 192.168.27.128:80

# SSH
#   ssh -p 8889 root@localhost
#8889 = 192.168.27.128:22

[incomingudp]
# UDP port forwarding example
    #6000 = 192.168.27.128:6001
```

Using Samba with Workstation

If you have Samba running on your Linux host, you can configure Samba so that it works with Workstation, as described in this section.

Modify your Samba configuration so that it includes the IP subnet used by the Workstation virtual Ethernet adapter, VMnet1.

To determine which subnet is being used by VMnet1, run:

```
/sbin/ifconfig vmnet1
```

Make sure the Samba password file includes entries for all users of the virtual machine who will access the host's file system. The user names and passwords in the Samba password file must match those used for logging on to the guest operating system.

You can add user names and passwords to the Samba password file at any time from a terminal window on your Linux host computer.

To add users to the Samba password file

1 Log on to the root account:

```
su
```

2 Run the Samba password command:

```
smbpasswd –a <username>
```

`<username>` is the user name to add.

3 Follow the instructions on the screen.

4 Log out of the root account:

```
exit
```

Using a Samba Server for Bridged and Host-Only Networks

To use your Samba server for both host-only and bridged networking, you must modify one parameter in the `smb.conf` file. You can define the `interface` parameter so your Samba server serves multiple interfaces. An example of this is:

```
interface = eth0 vmnet1
```

This example tells the Samba server to listen to and use both the eth0 and vmnet1 interfaces, which are the interfaces used by bridged and host-only networking, respectively.

Using Samba Without Network Access

To make Samba inaccessible from your physical Ethernet interface, add this line:

```
interfaces = vmnet*
```

to `/etc/samba/smb.conf` and restart Samba.

Configuring Video and Sound

14

The following sections provide information on configuring the video display and sound for VMware Workstation. This chapter includes the following topics:

- "Setting Screen Color Depth" on page 319
- "Experimental Support for Direct3D" on page 320
- "Configuring Sound" on page 325

Setting Screen Color Depth

The number of screen colors available in the guest operating system depends on the screen color setting of the host operating system.

Virtual machines support:

- 16-color (VGA) mode
- 8-bit pseudocolor
- 16 bits per pixel (16 significant bits per pixel)
- 32 bits per pixel (24 significant bits per pixel)

If the host is in 15-bit color mode, the guest operating system's color setting controls offer 15-bit mode in place of 16-bit mode.

If the host is in 24-bit color mode, the guest operating system's color setting controls offer 24-bit mode in place of 32-bit mode.

If you run a guest operating system set for a greater number of colors than your host operating system is using, you can encounter various problems. In some cases, for example, the colors in the guest are not correct. In others, the guest operating system is not able to use a graphical interface.

You can try either of the following solutions:

- Increase the number of colors available on the host, as described in "Changing Screen Color Depth on the Host" on page 320.
- Decrease the number of colors used in the guest, as described in "Changing Screen Color Depth in the Virtual Machine" on page 320.

For best performance, use the same number of colors in the guest and on the host.

Changing Screen Color Depth on the Host

If you choose to change the color settings on your host operating system, shut down all guest operating systems, power off the virtual machines, and close Workstation.

Follow standard procedures for changing the color settings on your host operating system, and then restart Workstation and the virtual machines.

Changing Screen Color Depth in the Virtual Machine

If you choose to change the color settings in the guest operating system, the approach you take depends on the guest operating system.

Follow the normal process for changing screen colors in your guest operating system:

- In a Windows guest, the Display Properties control panel offers only those settings that are supported.
- In a Linux or FreeBSD guest, you must change the color depth before you start the X server or restart the X server after making the changes.

Experimental Support for Direct3D

Workstation includes experimental support for Direct3D video acceleration. This feature is not fully functional.

CAUTION Features with experimental support are not intended to be enabled on production systems. Enabling 3-D acceleration might cause the host or guest to crash, causing you to lose data, even if 3-D applications are not active.

To take advantage of the experimental 3-D capabilities of Workstation, the virtual machine must be running the version of VMware Tools that corresponds to the version of Workstation you are using to run it. For example, a virtual machine running on Workstation 6.0 must be running the version of VMware Tools provided with Workstation 6.0. If you move the virtual machine and want to use the 3-D capabilities, be sure you have the correct version of VMware Tools installed.

Audience for Direct3D Experimental Support

Workstation provides this feature for advanced customers who want to explore an in-progress implementation of 3-D acceleration.

Technical support for accelerated 3-D is not yet provided for Workstation. However, you are encouraged to file a support request so VMware can evaluate problems you experience with accelerated 3-D. Review "Helping VMware with Experimental Support" on page 324 before you file a support request.

Accelerated 3-D Limitations

Experimental support for Direct3D applies only to Windows 2000 and Windows XP guests, on hosts running Windows 2000, Windows XP, Windows Vista, or Linux.

Experimental support has the following limitations:

- Workstation accelerates DirectX 8 applications and DirectX 9 applications that use only the subset of DirectX 8.
- Support for 3-D applications is not optimized for performance.
- OpenGL applications run in software emulation mode.

Not all aspects of 3-D acceleration are enabled. The following 3-D features are not accelerated:

- Pixel and vertex shaders
- Multiple vertex streams
- Hardware bump-mapping, environment mapping
- Projected textures
- Textures with one, three, or four dimensions

Enabling Accelerated 3-D

By default, Direct3D technology is disabled. You must prepare the host first, the virtual machine second, and the guest operating system last.

CAUTION Features with experimental support are not intended for production systems.

To enable a host for accelerated 3-D

1 With regards to hardware, use a host video card with support for accelerated OpenGL, such as NVIDIA TNT, GeForce and Quadro cards, or ATI FireGL and Radeon 8500 (or higher) video cards.

If you are unsure, check with your hardware manufacturer.

2 With regards to software, upgrade the host's video drivers to the latest version available:

- ATI drivers are available at:

  ati.amd.com/support/driver.html

- NVIDIA drivers are available at:

  www.nvidia.com/content/drivers/drivers.asp

3 If you are using a Windows 2000 or Windows XP host, make sure hardware acceleration is turned up in the display properties:

a Right-click the desktop and choose **Properties>Settings>Advanced>Troubleshoot**.

b Move the **Hardware Acceleration** slider all the way to the **Full** position.

4 If you are using Linux, test your Linux host for compatibility:

a To verify that direct rendering is enabled, run:

```
glxinfo | grep direct
```

b To ensure that 3-D applications work on your host, run:

```
glxgears
```

After your host is configured, configure a virtual machine for accelerated 3-D.

To enable a virtual machine for accelerated 3-D

1 Choose a virtual machine with Windows 2000 or XP guest operating system.

Do not enable Direct3D on a virtual machine that is powered on or suspended.

2 If the virtual machine is set to use more than one monitor, use the virtual machine settings editor to set it back to using only one monitor.

Make sure the virtual machine is powered off, and then select it, choose **VM>Settings>Hardware>Display**, and specify one monitor.

3 Add the following to the configuration (`.vmx`) file for the virtual machine:

```
mks.enable3d = "TRUE"
```

This line enables accelerated 3-D on the host. It is required to support accelerated 3-D in the guest and also enables the host to accelerate 2-D portions of the guest display.

4 Also add one or both of the following optional lines:

```
svga.vramSize = "67108864"
```

This line increases the amount of VRAM on the virtual display card to 64MB. Adding more VRAM helps to reduce thrashing in the guest. The maximum value is 128MB.

```
vmmouse.present = "FALSE"
```

This line disables the absolute pointing device in the guest. Applications that require DirectInput relative mode require that you turn off the absolute pointing device in the guest. In practice, this is only required for a certain class of full screen 3-D applications (for example, real-time games like first-person shooters).

5 If you set the `vmmouse.present` option, also turn off the preference for motion ungrabbing in the Workstation preferences, as follows:

a From the Workstation menu bar, choose **Edit>Preferences**.

b Click the **Input** tab.

c Deselect **Ungrab when cursor leaves window**.

To enable the guest operating system for accelerated 3-D

1 Power on the virtual machine.

2 Install VMware Tools.

For instructions, see "Installing and Upgrading VMware Tools" on page 113.

3 Install DirectX 9.0c End User Runtime.

This download is available from Microsoft at:

www.microsoft.com/downloads/search.aspx?displaylang=en&categoryid=2

4 Install and run your 3-D applications.

Known Issues

Common problems for Direct3-D experimental support include the following:

- Switching tabs in the VMware Workstation console does not work while 3-D applications are running.
- Switching between full screen and windowed mode does not work while 3-D applications are running.
- Running multiple 3-D applications simultaneously might crash the Workstation application.
- When a 3-D application is running, you cannot suspend or resume the virtual machine, and you cannot take snapshots.
- Graphical corruption occurs, such as:
  - Screen shot or movie capture displays graphical corruption for the 3-D area of the screen.
  - The guest cursor occasionally has a halo of corruption (usually white) when mousing over 3-D regions in the guest operating system.

Helping VMware with Experimental Support

VMware offers only experimental support for Direct3D acceleration. VMware might not respond personally to all support requests regarding Direct3D acceleration.

VMware is interested in the following types of issues:

- Catastrophic failures such as blue-screening the guest, or 3-D applications that crash Workstation.
- Testing reports about ATI 8500 (and later) video cards (whether or not they work).
- Testing reports about Linux host operating systems (whether or not they work).
- Testing reports about specific DirectX8 and DX9 applications you are using (whether or not they work).
- Specific problems you are having when running 3-D.
- Specific directions in which you want to see VMware 3-D technology evolve.

Specific and detailed reports can help speed this feature from experimental support to full functionality. Include as many details about your configuration, 3-D applications, and hardware as you can.

Configuring Sound

Workstation provides a sound device compatible with the Sound Blaster AudioPCI and supports sound in Windows 95, Windows 98, Windows Me, Windows NT, Windows 2000, Windows XP, Windows Server 2003, and Linux guest operating systems. The Workstation sound device is enabled by default.

Sound support includes PCM (pulse code modulation) output and input. For example, you can play `.wav` files, MP3 audio, and Real Media audio. MIDI output from Windows guests is supported through the Windows software synthesizer. MIDI input is not supported, and no MIDI support is available for Linux guests.

Windows 2000, Windows XP, and most recent Linux distributions automatically detect the sound device and install appropriate drivers for it.

For Windows Vista, when you install VMware Tools in a 64-bit Windows Vista guest operating system, a sound driver is installed. For 32-bit Windows Vista guests and Windows 2003 Server guests, you need to use Windows Update to install a 32-bit driver.

Installing Sound Drivers in Windows 9x and NT Guests

Windows 95, Windows 98, Windows 98SE, and Windows NT 4.0 do not have drivers for the Sound Blaster AudioPCI adapter. To use sound in these guest operating systems, download the driver from the Creative Labs Web site (www.creative.com) and install it in the guest operating system.

Creative Labs has a number of Web sites serving various regions of the world. The adapter name varies, depending on the region, but usually includes PCI 128.

Connecting Devices 15

This chapter describes how to use various devices with a virtual machine. This chapter includes the following topics:

- "Using Parallel Ports" on page 327
- "Using Serial Ports" on page 333
- "Configuring Keyboard Features" on page 341
- "Using USB Devices in a Virtual Machine" on page 351
- "Connecting to a Generic SCSI Device" on page 357
- "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 365

Using Parallel Ports

Parallel ports are used by a variety of devices, including printers, scanners, dongles, and disk drives.

Currently, Workstation provides only partial emulation of PS/2 hardware. Interrupts requested by a device connected to the physical port are not passed to the virtual machine. Also, the guest operating system cannot use DMA (direct memory access) to move data to or from the port. For this reason, not all devices that attach to the parallel port are guaranteed to work correctly.

Installation in Guest Operating Systems

If the virtual machine is configured with a parallel port, most guest operating systems detect it at installation time and install the required drivers. Some operating systems, including Linux, Windows NT, and Windows 2000, automatically detect the ports at boot time. Others, like Windows 95 and Windows 98, do not.

To add a parallel port to the virtual machine's configuration

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the New Hardware wizard.

4 Select **Parallel Port** and click **Next**.

5 Make the appropriate selection to use a physical parallel port or connect the virtual parallel port to a file.

6 Specify which option you want to use for the parallel port:

- If you select **Use physical parallel port**, click **Next** and choose the port from the drop-down list.
- If you select **Output file**, click **Next** and enter the path and filename or browse to the location of the file.

7 Under **Device status**, if you do not want the parallel port to connect at power on clear the check box.

8 Click **Finish**.

In a Windows 95 or Windows 98 guest, after you add the port, run the guest operating system's Add New Hardware wizard (**Start>Settings>Control Panel>Add New Hardware**) and let Windows detect the new device.

Configuring a Parallel Port on a Linux Host

For the parallel port to work properly in a guest, it must first be configured properly on the host. Most issues involving parallel port functionality are a result of the host configuration. This section provides instructions for checking the following areas of concern: the version of your Linux kernel, your device access permissions, and the required modules. This section includes the following topics:

- "Parallel Ports and Linux 2.2.x Kernels" on page 329
- "Parallel Ports and Linux 2.4.x Kernels" on page 330
- "Parallel Ports and Linux 2.6.x Kernels" on page 331
- "Device Permissions" on page 332

Parallel Ports and Linux 2.2.x Kernels

The 2.2.x kernels that support parallel ports use the `parport`, `parport_pc`, and `vmppuser` modules. Be sure that PC Style Hardware (CONFIG_PARPORT_PC) is loaded as a module. On Linux hosts, Workstation requires that the parallel port "PC-style hardware" option (CONFIG_PARPORT_PC) be built and loaded as a kernel module (that is, it must be set to "m"). Workstation is unable to use parallel port devices if CONFIG_PARPORT_PC is built directly (compiled) into the kernel. This limitation exists because CONFIG_PARPORT_PC does not correctly export its symbols.

The `vmppuser` module is supplied by Workstation to give virtual machines user-level access to the parallel port.

To check the configuration

1 Determine whether the `parport`, `parport_pc`, and `vmppuser` modules are installed and running on your system by running the `lsmod` command as the root user.

   These three modules should be included in the listing of running modules. You can also look at the `/proc/modules` file for the same list.

2 To load the proper modules, run this command:

   ```
   insmod <modulename>
   ```

3 If none of the listed parallel port modules is loaded, use this command:

   ```
   insmod parport_pc
   ```

   This command inserts the three modules needed for a parallel port.

   If you continue to see problems, it is possible that the `lp` module is running. If it is, the virtual machine cannot use the parallel port correctly.

4 If the `lp` module is loaded, run this command as the root user to remove it:

   ```
   rmmod lp
   ```

5 Verify that the line referring to the `lp` module in the `/etc/modules.conf` or `/etc/conf.modules` file is removed or commented out by inserting a hash character (#) at the beginning of the line.

   The name of the configuration file depends on the Linux distribution you are using. When you reboot the host after removing this line, the configuration file no longer starts the `lp` module.

6 To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the `/etc/modules.conf` or `/etc/conf.modules` file:

   ```
   alias parport_lowlevel parport_pc
   ```

Parallel Ports and Linux 2.4.x Kernels

Be sure that PC Style Hardware (CONFIG_PARPORT_PC) is loaded as a module (that is, it must be set to "m"). If you are using a 2.4.x kernel, the modules that provide parallel port functionality are `parport`, `parport_pc`, and `ppdev`.

Also be sure to enable support for user-space parallel device drivers (CONFIG_PPDEV).

To check the configuration

1 Determine whether the `parport`, `parport_pc`, and `ppdev` modules are installed and loaded on your system by running the `lsmod` command as the root user.

These three modules should be included in the listing of loaded modules. You can also look at the `/proc/modules` file for the same list.

2 To load the proper modules, run this command:

```
insmod <modulename>
```

3 If none of the listed parallel port modules is loaded, use this command:

```
insmod parport_pc
```

This command inserts the `parport and parport_pc`modules needed for a parallel port.

4 Use this command to load the `ppdev` module:

```
insmod ppdev
```

If you continue to see problems, it is possible that the `lp` module is loaded. If it is, the virtual machine cannot use the parallel port correctly.

5 If the `lp` module is loaded, run this command as the root user to remove it:

```
rmmod lp
```

6 Verify that the line referring to the `lp` module in the `/etc/modules.conf` or `/etc/conf.modules` file is removed or commented out by inserting a hash character (#) at the beginning of the line.

The name of the configuration file depends on the Linux distribution you are using. When you reboot the host after removing this line, the configuration file no longer starts the `lp` module.

7 To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the `/etc/modules.conf` or `/etc/conf.modules` file:

```
alias parport_lowlevel parport_pc
```

Linux kernels in the 2.4.x series also use a special arbitrator that allows access to the parallel port hardware. If the parallel port is in use by the host, the guest cannot use it. If a virtual machine is using the parallel port, the host and any users accessing the host are not given access to the device. Workstation puts a lock on the device, and this lock restricts access so that only the virtual machine can use the port.

From the VMware Workstation menu bar, you can choose **VM>Removable Devices** to disconnect the parallel port from the virtual machine and reconnect it.

Parallel Ports and Linux 2.6.x Kernels

Be sure that PC Style Hardware (CONFIG_PARPORT_PC) is loaded as a module (that is, it must be set to "m"). If you are using a 2.6.x kernel, the modules that provide parallel port functionality are `modprobe <modulename>` and `modprobe parport_pc`.

To check the configuration

1 Determine whether the `modprobe <modulename>` and `modprobe parport_pc` modules are installed and loaded on your system by running the `lsmod` command as the root user.

You can also look at the `/proc/modules` file for the same list.

With 2.6.x, loading `parport_pc` does not load all modules.

2 If none of the listed parallel port modules is loaded, use this command:

```
modprobe parport_pc && modprobe ppdev
```

This command inserts the modules needed for a parallel port.

If you continue to see problems, it is possible that the `lp` module is loaded. If it is, the virtual machine cannot use the parallel port correctly.

3 If the `lp` module is loaded, run this command as the root user to remove it:

```
rmmod lp
```

4 Verify that the line referring to the `lp` module in the `/etc/modules.conf` or `/etc/conf.modules` file is removed or commented out by inserting a hash character (#) at the beginning of the line.

The name of the configuration file depends on the Linux distribution you are using. When you reboot the host after removing this line, the configuration file no longer starts the `lp` module.

5 To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the `/etc/modules.conf` or `/etc/conf.modules` file:

```
alias parport_lowlevel parport_pc
```

Linux kernels in the 2.6.x series also use a special arbitrator that allows access to the parallel port hardware. If the parallel port is in use by the host, the guest cannot use it. If a virtual machine is using the parallel port, the host and any users accessing the host are not given access to the device. Workstation puts a lock on the device, and this lock restricts access so that only the virtual machine can use the port.

You can choose **VM>Removable Devices** to disconnect the parallel port from the virtual machine and reconnect it.

Device Permissions

Some Linux distributions by default do not grant the virtual machine access to the `lp` and `parport` devices. In most of these cases, the owner of the device is `root` and the associated group is `lp`. To allow the VMware user to access the device, add the user to the associated group. To view the owner and group of the device, run this command:

```
ls -la /dev/parport0
```

The third and fourth columns of the output show the owner and group, respectively.

To add the user to the device group, edit the `/etc/group` file. On the line starting with `lp`, which defines the `lp` group, add the Workstation user's user name. You must make this change as the root user. The following line provides an example for a user whose user name is `userj`.

```
lp::7:daemon,lp,userj
```

The next time the user logs on to the host, the changes take effect.

Special Notes for the Iomega Zip Drive

On Windows 95 or Windows 98, use of older drivers for the Iomega Zip drive might cause the guest operating system to lock up intermittently at boot time or during installation of the guest operating system. The newest Iomega drivers work reliably in VMware tests. They are available from the Iomega web site. Go to www.iomega.com and click on **Support & Downloads**.

Using Serial Ports

A Workstation virtual machine can use up to four virtual serial ports. The virtual serial ports can be configured in several ways:

- Connect a virtual serial port to a physical serial port on the host computer.
- Connect a virtual serial port to a file on the host computer.
- Make a direct connection between two virtual machines or between a virtual machine and an application running on the host computer.

This section provides instructions for all these options. You can also select whether to connect the virtual serial port when you power on the virtual machine.

Using a Serial Port or a File on the Host Computer

You can set up the virtual serial port in a virtual machine to use a physical serial port on the host computer. This is useful, for example, if you want to use an external modem or a hand-held device in your virtual machine.

Alternatively, you can set up the virtual serial port in a virtual machine to send its output to a file on the host computer. This is useful, for example, if you want to capture the data a program running in the virtual machine sends to the virtual serial port or if you need a quick way to transfer a file from the guest to the host.

To install a virtual serial port that connects to a physical serial port or a file

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Serial Port** and click **Next**.

5 On the Serial Port Type page, select either **Use physical serial port on the host** or **Output to file** and click **Next**.

6 Depending on whether you want to use a physical serial port or a file, do one of the following:

- For a physical serial port, on the Select a Physical Serial Port page, choose the port on the host computer that you want to use for this serial connection.
- For a file, on the Choose Serial Port Output File page, browse to the file on the host computer that you want to use to store the output of the virtual serial port.

7 Make sure the **Connect at power on** check box is selected if desired.

8 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

9 (Windows hosts only) On the **Hardware** tab, to configure this serial port to use polled mode, select **Yield CPU on poll**.

This option is of interest to developers who are using debugging tools that communicate over a serial connection. For more information, see "Configuration Options for Advanced Users" on page 338.

10 Power on the virtual machine.

Connecting an Application on the Host to a Virtual Machine

You can set up the virtual serial port in a virtual machine to connect to an application on the host computer. This is useful, for example, if you want to use an application on the host to capture debugging information sent from the virtual machine's serial port.

To install a direct serial connection between an application on the host and a virtual machine, use the following procedure.

To connect a host application to a virtual machine

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Serial Port** and click **Next**.

5 On the Serial Port Type page, select **Output to Named Pipe** and click **Next**.

6 Depending on whether you are using a Linux host or a Windows host, do one of the following:

- For a Windows host: On the Specify Named Pipe page, accept the default pipe name or enter another pipe name. The pipe name must follow the form `\\.\pipe\<namedpipe>`—that is, it must begin with `\\.\pipe\`.
- For a Linux host: In the **Path** field, enter `/tmp/<socket>` or another UNIX socket name of your choice.

7 Select **This end is the server** or **This end is the client**.

Select **This end is the server** if you plan to start this end of the connection first.

8 Select **The other end is an application**.

9 Make sure the **Connect at power on** check box is selected if desired.

10 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

11 (Windows hosts only) On the **Hardware** tab, to configure this serial port to use polled mode, select **Yield CPU on poll**.

This option is of interest to developers who are using debugging tools that communicate over a serial connection. For more information, see "Configuration Options for Advanced Users" on page 338.

12 On your host computer, configure the application that communicates with the virtual machine to use the same pipe name (for a Windows host) or the same UNIX socket name (for a Linux host).

13 Power on the virtual machine.

Connecting Two Virtual Machines

You can set up the virtual serial ports in two virtual machines to connect to each other. This is useful, for example, if you want to use an application in one virtual machine (the client) to capture debugging information sent from the other (the server) virtual machine's serial port.

The following procedures describe how to set up the server and the client for connecting to each other by two virtual serial ports.

To set up the server side of the connection

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Serial Port** and click **Next**.

5 On the Serial Port Type page, select **Output to Named Pipe** and click **Next**.

6 Depending on whether you are using a Linux host or a Windows host, do one of the following:

- For a Windows host: On the Specify Named Pipe page, accept the default pipe name or enter another pipe name. The pipe name must follow the form `\\.\pipe\<namedpipe>`—that is, it must begin with `\\.\pipe\`.
- For a Linux host: In the **Path** field, enter `/tmp/<socket>` or another UNIX socket name of your choice.

7 Select **This end is the server**.

8 Select **The other end is a virtual machine**.

9 Make sure the **Connect at power on** check box is selected if desired.

10 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

11 (Windows hosts only) On the **Hardware** tab, to configure this serial port to use polled mode, select **Yield CPU on poll**.

This option is of interest to developers who are using debugging tools that communicate over a serial connection. For more information, see "Configuration Options for Advanced Users" on page 338.

12 Power on the virtual machine.

To set up the client side of the connection

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Serial Port** and click **Next**.

5 On the Serial Port Type page, select **Output to Named Pipe** and click **Next**.

6 Depending on whether you are using a Linux host or a Windows host, do one of the following:

- For a Windows host: On the Specify Named Pipe page, accept the default pipe name or enter another pipe name. The pipe name must follow the form `\\.\pipe\<namedpipe>`—that is, it must begin with `\\.\pipe\`.
- For a Linux host: In the **Path** field, enter `/tmp/<socket>` or another UNIX socket name of your choice. The pipe name must be the same on both server and client.

7 Select **This end is the client**.

8 Select **The other end is a virtual machine**.

9 Make sure the **Connect at power on** check box is selected if desired.

10 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

11 (Windows hosts only) On the **Hardware** tab, to configure this serial port to use polled mode, select **Yield CPU on poll**.

This option is of interest to developers who are using debugging tools that communicate over a serial connection. For more information, see "Configuration Options for Advanced Users" on page 338.

12 Power on the virtual machine.

Configuration Options for Advanced Users

Two special configuration options are available for serial connections between a virtual machine and the host or between two virtual machines:

- "Yielding CPU on Poll to Improve Performance When Debugging (Windows Hosts Only)" on page 338
- "Changing the Input Speed of the Serial Connection" on page 338

These options are of interest primarily to developers who are using debugging tools that communicate over a serial connection.

Yielding CPU on Poll to Improve Performance When Debugging (Windows Hosts Only)

This option is useful when the serial port is being used by the guest operating system in polled mode as opposed to interrupt mode. Polled mode causes the virtual machine to consume a disproportionate share of CPU time, which can cause the host and other guests run sluggishly.

The following procedure describes how to set an option to force the affected virtual machine to yield processor time if the only task it is trying to do is poll the virtual serial port.

To improve the performance of applications on the Windows host

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered off or powered on.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 On the **Hardware** tab, select **Serial Port**.

4 (Windows hosts only) In the **I/O mode** section, select **Yield CPU on poll** and click **OK**.

Changing the Input Speed of the Serial Connection

This option increases the speed of your serial connection over a pipe to the virtual machine. In principle, there is no limit on the output speed, which is the speed at which the virtual machine sends data through the virtual serial port. In practice, the output speed depends on how fast the application at the other end of the pipe reads data inbound to it.

To change the input speed of the serial connection

1 Use the guest operating system to configure the serial port for the highest setting supported by the application you are running in the virtual machine.

2 Power off the virtual machine and close the Workstation window.

3 Use a text editor to add the following line to your virtual machine's configuration (`.vmx`) file:

```
serial<n>.pipe.charTimePercent = "<x>"
```

`<n>` is the number of the serial port, starting from `0`. So the first serial port is `serial0`.

`<x>` is a positive integer that specifies the time taken to transmit a character, expressed as a percentage of the default speed set for the serial port in the guest operating system. For example, a setting of `200` forces the port to take twice as long per character, or send data at half the default speed. A setting of `50` forces the port to take only half as long per character, or send data at twice the default speed.

Assuming that the serial port speed is set appropriately in the guest operating system, experiment with this setting. Start with a value of `100` and gradually decrease it until you find the highest speed at which your connection works reliably.

Examples: Debugging over a Virtual Serial Port

You can use Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) to debug kernel code in a virtual machine over a virtual serial port. Download Debugging Tools for Windows from the Windows DDK Web site at www.microsoft.com/whdc/devtools/debugging/default.mspx.

The following two examples illustrate how to use a virtual serial port to debug kernel code in a virtual machine:

- With the debugging application on the Workstation host (Windows hosts only)
- With the debugging application in another virtual machine on the same Workstation host (useful on a Linux host and can also be done on a Windows host)

Using either of these methods lets you debug kernel code on one system, without the need for two physical computers, a modem, or a serial cable.

Debugging an Application in a Virtual Machine from the Windows Host

In this example, you have kernel code to debug in a virtual machine (called the target virtual machine) and are running `WinDbg` or `KD` on your Windows host.

To debug an application from a Windows host

1 Prepare the target virtual machine, as described in "Connecting an Application on the Host to a Virtual Machine" on page 334.

Make sure you configure the virtual machine's virtual serial port as follows:

a Select **This end is the server**.

b Under **I/O Mode**, select the **Yield CPU on poll** check box, because the kernel in the target virtual machine uses the virtual serial port in polled mode, not interrupt mode.

2 Prepare the host: Make sure you have a recent version of Debugging Tools for Windows—one that supports debugging over a pipe.

You need version 5.0.18.0 or higher.

3 Power on the virtual machine.

4 Make sure the serial port is connected, as follows: From the Workstation menu bar, choose **VM>Removable Devices**.

On that menu, **Serial<n>** should be reported as `\\.\pipe\<namedpipe>` (on Windows hosts) or `/tmp/<socket>` (on Linux hosts). If the serial port is not connected, choose the virtual serial port and click **Connect**.

5 On the host, open a command prompt window and do one of the following:

- If you are using `WinDbg`, type the following:

```
windbg -k com:port=\\.\pipe\<namedpipe>,pipe
```

- If you are using `KD`, type the following:

```
kd -k com:port=\\.\pipe\<namedpipe>,pipe
```

6 Press Enter to start debugging.

Debugging an Application in a Virtual Machine from Another Virtual Machine

In this situation, you have kernel code to debug in a virtual machine (called the target virtual machine) and are running Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) in another virtual machine (called the debugger virtual machine) on the same host.

This is useful if you are running Workstation on a Linux host. The debugger virtual machine must be running Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) in a Windows guest operating system.

To debug an application from another virtual machine

1 Prepare the target virtual machine: Use the appropriate platform-specific procedure for the server virtual machine described in "Connecting Two Virtual Machines" on page 335.

On Windows hosts, make sure when you configure the target virtual machine's virtual serial port that you select the **Yield CPU on poll** check box, because the kernel in the target virtual machine uses the virtual serial port in polled mode, not interrupt mode.

2 For the debugger virtual machine, make sure you have downloaded Debugging Tools for Windows.

3 Follow the steps for the client virtual machine in "Connecting Two Virtual Machines" on page 335.

4 Power on both virtual machines.

5 Make sure the serial port is connected: Choose choose **VM>Removable Devices**.

If the serial port is not connected, choose the virtual serial port and click **Connect**.

6 In the debugger virtual machine, start debugging with WinDbg or KD normally.

Configuring Keyboard Features

This section includes the following topics:

- "Enhanced Virtual Keyboard for Windows Hosts" on page 341
- "Hot Keys" on page 342
- "Specifying a Language Keymap for VNC Clients" on page 343
- "Keyboard Mapping on a Linux Host" on page 344

Enhanced Virtual Keyboard for Windows Hosts

This feature provides better handling of international keyboards and keyboards with extra keys. It also offers security improvements, as it processes raw keyboard input as soon as possible, bypassing Windows keystroke processing and any malware that's not already at a lower layer. This feature is currently available for all 32-bit Windows guests except Windows Vista guests.

If you use this feature, when you press Ctrl+Alt+Delete, the guest system only, rather than both guest and host, will act on the command.

To use the enhanced virtual keyboard on Windows hosts

1 Start Workstation on the Windows host and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **General**.

4 To enable or disable the setting, use the check box called **Use enhanced virtual keyboard** and click **OK**.

If you have just installed Workstation or upgraded to Workstation 6, you might need to restart the host computer before turning on this setting.

Hot Keys

Hot keys let you specify the key combination that is used with hot-key sequences for all your virtual machines. For example, you can require that all hot-key sequences use Ctrl+Shift+Alt. This is useful if you want to prevent certain key combinations (such as Ctrl+Alt+Del) from being intercepted by Workstation instead of being sent to the guest operating system.

Use hot-key sequences to:

- Switch between virtual machines
- Enter and leave full screen mode
- Ungrab input
- Send Ctrl+Alt+Del to the virtual machine only (not to the host machine)
- Send commands to the virtual machine only (not to the host machine)

Because Ctrl+Alt tells Workstation to release (ungrab) mouse and keyboard input, combinations that include Ctrl+Alt are not passed to the guest operating system. If you need to use such a combination—for example, use Ctrl+Alt+<Fkey> to switch between Linux workspaces in a virtual machine—press Ctrl+Alt+Space, release Space without releasing Ctrl and Alt, and press the third key of the key combination you want to send to the guest.

Use Workstation's preferences editor to specify which hot sequences you want to use. From the menu bar, choose **Edit>Preferences>Hot Keys**.

Specifying a Language Keymap for VNC Clients

If you set a virtual machine to act as a VNC server, you can specify which language you want to use for the keyboard that VNC clients use. By default, the US101 keyboard map (U.S. English) is used.

To specify which keymap to use for VNC clients

1 Set the virtual machine to act as a VNC server, as described in "Using a VNC Client for Remote Connections to a Virtual Machine" on page 182.

2 Use a text editor to open the configuration file (`.vmx` file) for the virtual machine and add the following lines:

- `RemoteDisplay.vnc.keyMap = "<xx>"`

  where `<xx>` is the code for the language you want to use, such as `jp` for Japanese. This setting tells the virtual machine which keyboard map file to use. It assumes that the keyboard map files are located in the Workstation installation directory: `/usr/lib/vmware/vnckeymap` on Linux and in `C:\Documents and Settings\All Users\Application Data\VMware\vnckeymap` on Windows. Following is a list of language codes:

  `de`: German

  `de-ch`: German (Switzerland)

  `es`: Spanish

  `fi`: Finnish

  `fr`: French

  `fr-be`: French (Belgium)

  `fr-ch`: French (Switzerland)

  `is`: Icelandic

  `it`: Italian

  `jp`: Japanses

  `nl-be`: Dutch (Belgium)

  `no`: Norwegian

  `pt`: Polish

  `uk`: UK English

  `us`: US English

If the keyboard map file you want to use is in some other location, you can set the property `RemoteDisplay.vnc.keyMapFile` instead of `RemoteDisplay.vnc.keyMap`. Set `RemoteDisplay.vnc.keyMapFile` to an absolute file path.

- `RemoteDisplay.vnc.enabled = "TRUE"`
- `RemoteDisplay.vnc.port = "<port number>"`

  where `<port number>` is the port number you want to use.

3 Start the virtual machine and connect to it from a VNC client.

Keyboard Mapping on a Linux Host

This section addresses the following issues and provides additional details on keyboard mapping in Linux:

- Some language-specific keyboards do not appear to be supported by Workstation.
- Some of the keys on the keyboard don't work correctly in the virtual machine.
- The keyboard works fine when you run a virtual machine locally, but not when you run the same virtual machine with a remote X server.

If your keyboard works correctly with a local X server, and you just want the same behavior with a remote X server (which is also an XFree86 server running on a PC), first, power off the virtual machine and close the VMware Workstation window. Add the following line to the virtual machine configuration file or to `~/.vmware/config`:

```
xkeymap.usekeycodeMapIfXFree86 = "TRUE"
```

Make this change on the host machine, where you run the virtual machine, not on the machine with the remote X server.

If you are using an XFree86-based server that Workstation does not recognize as an XFree86 server, use this line instead:

```
xkeymap.usekeycodeMap = "TRUE"
```

If you are using an XFree86 server running locally, and the keyboard does not work correctly, report the problem to VMware technical support.

X Key Codes Versus Keysyms

Pressing a key on the PC keyboard generates a scan code based roughly on the position of the key. For example, the Z key on a German keyboard generates the same code as the Y key on an English keyboard, because they are in the same position on the

keyboard. Most keys have one-byte scan codes, but some keys have two-byte scan codes with prefix 0xe0.

Internally, Workstation uses a simplified version of the PC scan code that is a single nine-bit numeric value, called a v-scan code. A v-scan code is written as a three-digit hexadecimal number. The first digit is 0 or 1. For example, the left-hand Ctrl key has a one-byte scan code (0x1d); its v-scan code is 0x01d. The right-hand Ctrl key scan code is two bytes (0xe0, 0x1d); its v-scan code is 0x11d.

An X server uses a two-level encoding of keys. An X key code is a one-byte value. The assignment of key codes to keys depends on the X server implementation and the physical keyboard. As a result, an X application normally cannot use key codes directly. Instead, the key codes are mapped into keysyms that have names like space, escape, x and 2. The mapping can be controlled by an X application by using the function `XChangeKeyboardMapping()` or by the program `xmodmap`. To explore keyboard mappings, you can use `xev`, which shows the key codes and keysyms for keys typed into its window.

A key code corresponds roughly to a physical key, while a keysym corresponds to the symbol on the key top. For example, with an XFree86 server running on a PC, the Z key on the German keyboard has the same key code as the Y key on an English keyboard. The German Z keysym, however, is the same as the English Z keysym, and different from the English Y keysym.

For an XFree86 server on a PC, there is a one-to-one mapping from X key codes to PC scan codes (or v-scan codes, which is what Workstation really uses). Workstation takes advantage of this fact. When it is using an XFree86 server on the local host, it uses the built-in mapping from X key codes to v-scan codes. This mapping is keyboard independent and should be correct for most, if not all, languages. In other cases (not an XFree86 server or not a local server), Workstation must map keysyms to v-scan codes by using a set of keyboard-specific tables.

Configuring How Key Codes Are Mapped

Key code mapping is simple, automatic, and foolproof. (Keysym mapping is more complex and is described later.) However, because the program cannot tell whether a remote server is running on a PC or on some other kind of computer, it uses key code mapping only with local X servers. This approach might have undesirable effects. This and other behavior related to key code mapping can be controlled by powering off the virtual machine, closing the VMware Workstation window, and using a text editor to

add configuration settings to the virtual machine's configuration (`.vmx`) file. Following are some configuration settings you might want to use:

- `xkeymap.usekeycodeMapIfXFree86 = "TRUE"`

  Use key code mapping if you are using an XFree86 server, even if it is remote.

- `xkeymap.usekeycodeMap = "TRUE"`

  Always use key code mapping regardless of server type.

- `xkeymap.nokeycodeMap = "TRUE"`

  Never use key code mapping.

- `xkeymap.keycode.<code> = "<v-scan code>"`

  If you are using key code mapping, map key code `<code>` to `<v-scan code>`. In this example, `<code>` must be a decimal number and `<v-scan code>` should be a C-syntax hexadecimal number (for example, `0x001`).

The easiest way to find the X key code for a key is to run `xev` or `xmodmap -pk`. Most of the v-scan codes are covered in "V-Scan Code Table" on page 347. The keysym mapping tables described in this section are also helpful.

Use this feature to make small modifications to the mapping. For example, to swap left Ctrl and Caps Lock, use the following lines:

```
xkeymap.keycode.64 = "0x01d # X Caps_Lock -> VM left ctrl"
xkeymap.keycode.37 = "0x03a # X Control_L -> VM caps lock"
```

These configuration lines can be added to your personal Workstation configuration (`~/.vmware/config`), or even to the host-wide (`/etc/vmware/config`) or installation-wide (usually `/usr/lib/vmware/config`) configuration.

Configuring How Keysyms Are Mapped

When key code mapping cannot be used (or is disabled), Workstation maps keysyms to v-scan codes. It does this using one of the tables in the `xkeymap` directory in the Workstation installation (usually `/usr//lib/vmware`).

Which table you should use depends on the keyboard layout. The normal distribution includes tables for PC keyboards for the United States and a number of European countries and languages. And for most of these, there are both the 101-key (or 102-key) and the 104-key (or 105-key) variants.

Workstation automatically determines which table to use by examining the current X keymap. However, its decision-making process can sometimes fail. In addition, each mapping is fixed and might not be completely correct for any given keyboard and X key code-to-keysym mapping. For example, a user might have swapped Ctrl and Caps

Lock using `xmodmap`. This means the keys are swapped in the virtual machine when using a remote server (keysym mapping) but are unswapped when using a local server (key code mapping).

Therefore, keysym mapping is necessarily imperfect. To make up for this defect, you can change most of the behavior by using configuration settings:

- `xkeymap.language = "<keyboard-type>"`

  Use this setting if Workstation has a table in `xkeymap` for your keyboard but can't detect it. `<keyboard-type>` must be one of the tables in the `xkeymap` directory. (See above for location.) However, the failure to detect the keyboard probably means the table isn't completely correct for you.

- `xkeymap.keysym.<sym> = "<v-scan code>"`

  If you use keysym mapping, map keysym `<sym>` to `<v-scan code>`. When you do, `<sym>` must be an X keysym name and `<v-scan code>` should be a C-syntax hexadecimal number (for example, `0x001`).

  The easiest way to find the keysym name for a key is to run `xev` or `xmodmap -pk`.

  The X header file `/usr/include/X11/keysymdef.h` has a complete list of keysyms. (The name of a keysym is the same as its C constant without the XK_ prefix.) Most v-scan codes are in "V-Scan Code Table" on page 347.

  The `xkeymap` tables themselves are also helpful. Use them to fix small errors in an existing mapping.

- `xkeymap.fileName = "<file-path>"`

  Use the keysym mapping table in `<file-path>`. A table is a sequence of configuration lines of the following form:

  ```
  <sym> = "<v-scan code>"
  ```

  where `<sym>` is an X keysym name, and `<v-scan code>` is a C-syntax hexadecimal number (for example, `0x001`). (See the explanation of `xkeymap.keysym` above for tips on finding the keysyms and v-scan codes for your keyboard.)

  Compiling a complete keysym mapping is difficult. It is best to start with an existing table and make small changes.

V-Scan Code Table

Table 15-1 shows the v-scan codes for the 104-key U.S. keyboard.

Table 15-1. V-Scan Codes for the 104-Key U.S. Keyboard

Symbol	Shifted Symbol	Location	V-Scan Code
Esc			0x001
1	!		0x002
2	@		0x003
3	#		0x004
4	$		0x005
5	%		0x006
6	^		0x007
7	&		0x008
8	*		0x009
9	(		0x00a
0	)		0x00b
-	_		0x00c
=	+		0x00d
Backspace			0x00e
Tab			0x00f
Q			0x010
W			0x011
E			0x012
R			0x013
T			0x014
Y			0x015
U			0x016
I			0x017
O			0x018
P			0x019
[	{		0x01a
]	}		0x01b
Enter			0x01c
Ctrl		left	0x01d

Table 15-1. V-Scan Codes for the 104-Key U.S. Keyboard (Continued)

Symbol	Shifted Symbol	Location	V-Scan Code
A			0x01e
S			0x01f
D			0x020
F			0x021
G			0x022
H			0x023
J			0x024
K			0x025
L			0x026
;			0x027
'			0x028
`			0x029
Shift		left	0x02a
\	|		0x02b
Z			0x02c
X			0x02d
C			0x02e
V			0x02f
B			0x030
N			0x031
M			0x032
,	<		0x033
.	>		0x034
/	?		0x035
Shift		right	0x036
*		numeric pad	0x037
Alt		left	0x038
Space bar			0x039
Caps Lock			0x03a

Table 15-1. V-Scan Codes for the 104-Key U.S. Keyboard (Continued)

Symbol	Shifted Symbol	Location	V-Scan Code
F1			0x03b
F2			0x03c
F3			0x03d
F4			0x03e
F5			0x03f
F6			0x040
F7			0x041
F8			0x042
F9			0x043
F10			0x044
Num Lock		numeric pad	0x045
Scroll Lock			0x046
Home	7	numeric pad	0x047
Up arrow	8	numeric pad	0x048
PgUp	9	numeric pad	0x049
-		numeric pad	0x04a
Left arrow	4	numeric pad	0x04b
5		numeric pad	0x04c
Right arrow	6	numeric pad	0x04d
+		numeric pad	0x04e
End	1	numeric pad	0x04f
Down arrow	2	numeric pad	0x050
PgDn	3	numeric pad	0x051
Ins	0	numeric pad	0x052
Del		numeric pad	0x053
F11			0x057
F12			0x058
Break	Pause		0x100
Enter		numeric pad	0x11c

Table 15-1. V-Scan Codes for the 104-Key U.S. Keyboard (Continued)

Symbol	Shifted Symbol	Location	V-Scan Code
Ctrl		right	0x11d
/		numeric pad	0x135
SysRq	Print Scrn		0x137
Alt		right	0x138
Home		function pad	0x147
Up arrow		function pad	0x148
Page Up		function pad	0x149
Left arrow		function pad	0x14b
Right arrow		function pad	0x14d
End		function pad	0x14f
Down arrow		function pad	0x150
Page Down		function pad	0x151
Insert		function pad	0x152
Delete		function pad	0x153
Windows		left	0x15b
Windows		right	0x15c
Menu			0x15d

The 84-key keyboard has a Sys Req key on the numeric pad. Its v-scan code is 0x054.

Keyboards outside the U.S. usually have an extra key (often < > or < > |) next to the left shift key. The v-scan code for this key is 0x056.

Using USB Devices in a Virtual Machine

Workstation provides two USB controllers, so that you can connect to both USB 1.1 and USB 2.0 devices:

- For USB 1.1, a UHCI controller with a virtual hub enables you to connect to more than two USB 1.1 devices.
- For USB 2.0, an EHCI controller enables you to connect to up to six USB 2.0 devices. For USB 2.0 support, your host machine must support USB 2.0, and you must enable USB 2.0 support in Workstation, as described in this section.

USB 2.0 support is available only for Workstation 6 virtual machines.

On the host system, when a USB 2.0 device connects to a port, the device connects to the EHCI controller and operates in USB 2.0 mode. A USB 1.1 device is automatically connected to a UHCI controller and operates in USB 1.1 mode. In Workstation 6 virtual machines, this same behavior is simulated if you select the check box called **Enable high-speed support for USB 2.0 devices** on the **VM>Settings>Hardware>USB Controller** tab. Select this check box to connect high-speed or isochronous USB devices such as webcams, speakers, and microphones.

Although your host operating system must support USB, you do not need to install device-specific drivers for your USB devices in the host operating system to use those devices only in the virtual machine.

NOTE Windows NT and Linux kernels older than 2.2.17 do not support USB.

On Windows XP guests, be sure to install the latest service pack if you want to use USB 2.0. If you use Windows XP with no service packs, the driver for the EHCI controller cannot be loaded.

On a Windows 2000 host computer with USB 2.0 support, use the Microsoft USB 2.0 driver for the USB controller. Third-party USB 2.0 drivers, such as those provided by some motherboard manufacturers, are not supported. For notes on replacing the third-party drivers, see "Replacing USB 2.0 Drivers on a Windows 2000 Host" on page 354.

VMware has tested a variety of USB devices with this release. If the guest operating system has appropriate drivers, you should be able to use PDAs, printers, storage (disk) devices, scanners, MP3 players, digital cameras, and memory card readers.

Modems and certain streaming data devices, such as speakers and webcams, do not work properly unless you enable USB 2.0 support, as described earlier in this section.

Enabling and Disabling the USB 2.0 Controller

The virtual machine's USB ports are enabled by default, although support for high-speed USB 2.0 devices is not supported by default. If you will not be using USB devices in a virtual machine, you can disable (or enable) its USB controller using the virtual machine settings editor (from the menu bar, choose **VM>Settings>Hardware>USB Controller**).

USB 2.0 support is available only for Workstation 6 virtual machines. To use USB 2.0 devices in a Workstation 5 virtual machine, you must upgrade the hardware compatibility level to Workstation 6.

Connecting USB Devices

The topics in this section describe automatic and manual connection of USB devices.

Automatic Connection of USB Devices

When a virtual machine is running, its window is the active window, and if you plug a USB device into the host computer, the device connects to the guest instead of the host. You can disable this autoconnect feature in the USB Controller panel of the virtual machine settings editor (from the menu bar, choose **VM>Settings>Hardware>USB Controller)**.

Connecting USB Devices Manually

Use the following procedure to manually connect specific USB devices to a virtual machine. Use this procedure if the device does not automatically connect to the virtual machine.

To connect a USB device manually

1 Select the virtual machine.

Make sure the virtual machine is powered on.

2 From the Workstation menu bar, choose **VM>Removable Devices>USB Devices><Device Name>**.

Here <Device Name> specifies the USB device that is plugged into your host computer. A check mark appears next to the device's name, indicating that it is connected.

If the physical USB devices are connected to the host computer through a hub, the virtual machine sees only the USB devices, not the hub.

If you physically plug a new device into the host computer and the autoconnect feature does not connect it to a virtual machine, this means the device is instead connected to the host. Its name is also added to the **VM>Removable Devices** menu so you can connect it to the virtual machine manually.

Automatic Reconnection of USB Devices

When you manually connect a USB device (by choosing **VM>Removable Devices**), Workstation retains the virtual machine's connection to the affected port on the host machine. You can suspend or power off the virtual machine, or unplug the device. When you plug the device back in or resume the virtual machine, Workstation reconnects the device. Workstation retains the connection by writing an autoconnect entry to the virtual machine's configuration (`.vmx`) file.

If Workstation is unable to reconnect to the device (for example, because the device has been disconnected), the device is removed, and a message is displayed, indicating that Workstation is unable to connect to the device. You can connect manually to the device, if it is still available.

Using USB with a Windows Host

When a particular USB device is connected to a virtual machine for the first time, the host detects it as a new device named VMware USB Device and installs the appropriate VMware driver.

On Windows XP and Windows Server 2003 hosts, confirmation is required in the Found New Hardware wizard. Select the default action, **Install the software automatically**. After the software is installed, the guest operating system detects the USB device and searches for a suitable driver.

When you are synchronizing a PDA, such as a Palm handheld or Handspring Visor, to a virtual machine for the first time, the total time required to load the VMware USB device driver in the host and the PDA driver in the guest might exceed the device's connection timeout value. This causes the device to disconnect itself from the computer before the guest can synchronize with it. If this occurs, let the guest finish installing the PDA driver, dismiss any connection error warnings, and try synchronizing the PDA again. The second attempt should succeed.

Replacing USB 2.0 Drivers on a Windows 2000 Host

To use VMware Workstation on a Windows 2000 host that has USB 2.0 ports, you must use the Microsoft USB 2.0 drivers for the USB controller in the host operating system. If your host operating system is using a third-party driver—a driver supplied by your motherboard vendor, for example—you must replace it.

To check the provider of your driver

1 Open the Device Manager, as follows:

   a Right-click **My Computer** and choose **Properties**.

   b Click the **Hardware** tab and click **Device Manager**.

2 Expand the listing for Universal Serial Bus controllers.

3 Right-click the listing for the controller and choose **Properties**.

4 Click the **Driver** tab.

   If the driver provider shown on that page is Microsoft, you have the correct driver already.

If the driver provider is not Microsoft, download the latest USB driver for your host operating system from the Microsoft Web site and follow the Microsoft instructions to install it. Details are available in Microsoft knowledge base article 319973.

Using USB with a Linux Host

On Linux hosts, VMware Workstation uses the USB device file system to connect to USB devices. In most Linux systems that support USB, the USB device file system is at `/proc/bus/usb`.

If your host operating system uses a different path to the USB device file system, run the following command as root to mount the file system to the expected location:

```
mount –t usbfs none /proc/bus/usb
```

If you attach a USB drive to a Linux machine, use the above-mentioned procedure to access it. Do not attempt to add a USB drive's device node (for example, `/dev/sda`) directory to the virtual machine as a hard disk. That is, to add a USB drive, use the Add Hardware wizard to add a *USB Controller*, not a hard disk.

How Device Control Is Shared Between Host and Guest

Only the host or the guest can have control of a USB device at any one time. Device control operates differently, depending on whether the host is a Linux or a Windows computer.

Device Control on a Windows Host

When you connect a device to a virtual machine, it is "unplugged" from the host or from the virtual machine that previously had control of the device. When you disconnect a device from a virtual machine, it is "plugged in" to the host.

CAUTION On Windows 2000, Windows XP, and Windows Server 2003 hosts, you need to take a special step to disconnect USB network and storage devices from the host before connecting them to a virtual machine. Use the appropriate system tray icon to disconnect the device from the host. On Windows 2000, the icon is called **Eject Hardware**, and on Windows XP and Windows Server 2003, it is called **Safely Remove Hardware**.

On Windows 2000, Windows XP, and Windows Server 2003 hosts, when you connect a USB network or storage device to a virtual machine, you might see a message on your host that says the device can be removed safely. This is normal behavior, and you can dismiss the dialog box. However, do *not* remove the device from your physical computer.

Under some circumstances, if a USB storage device is in use on the host (for example, one or more files stored on the device are open on the host), an error appears in the virtual machine when you try to connect to the device. You must let the host complete its operation or close any application connected to the device on the host, and then connect to the device in the virtual machine again.

Device Control on a Linux Host

On Linux hosts, guest operating systems can use devices that are not already in use by the host—that is, devices that are not claimed by a host operating system driver.

If your device is in use by the host and you try to connect it to the guest by using the **VM>Removable Devices** menu, a dialog box appears, asking whether you want to have Workstation disconnect the driver on the host.

If, for some reason, this disconnection fails, you can unload the device driver manually as root (`su –`) by using the `rmmod` command. Or, if the driver was automatically loaded by `hotplug`, you can disable it in the `hotplug` configuration files in the `/etc/hotplug` directory. See your Linux distribution's documentation for details on editing these configuration files.

A related issue sometimes affects devices that rely on automatic connection (as PDAs often do). If you have successfully used autoconnection to connect the device to your virtual machine but then experience problems with the connection to the device, try the following procedure.

To correct autoconnection problems

1 Disconnect and reconnect the device.

  You can either unplug it physically and plug it back in or use the **VM>Removable Devices** menu to disconnect it and reconnect it.

2 If you see a dialog box warning that the device is in use, disable it in the `hotplug` configuration files in the `/etc/hotplug` directory.

Disconnecting USB Devices from a Virtual Machine

Before unplugging a USB device or using the **VM>Removable Devices** menu to disconnect it from a virtual machine, be sure it is in a safe state.

Follow the procedures the device manufacturer specifies for unplugging the device from a physical computer. This is true whether you are physically unplugging it, moving it from host to virtual machine, moving it between virtual machines, or moving it from virtual machine to host.

This is important with data storage devices (a Zip drive, for example). If you move a data storage device too soon after saving a file and the operating system has not actually written the data to the disk, you can lose data.

Human Interface Devices

USB human interface devices, such as the keyboard and mouse, are not handled though the virtual machine's USB controller. Instead, they appear in the virtual machine as a standard PS/2 keyboard and mouse, even though they are plugged into USB ports on the host.

Connecting to a Generic SCSI Device

Generic SCSI lets a virtual machine run any SCSI device that is supported by the guest operating system in the virtual machine. Generic SCSI gives the guest operating system direct access to SCSI devices connected to the host, such as scanners and tape drives.

Generic SCSI on a Windows Host Operating System

Using the SCSI generic driver in Windows, Workstation allows your guest operating system to operate generic SCSI devices in a virtual machine. These devices include scanners, tape drives, and other data storage devices.

NOTE To access host SCSI devices as generic SCSI devices from within a virtual machine, you must run Workstation as a user with administrator access.

In theory, generic SCSI is completely device independent, but VMware has discovered it is sensitive to the guest operating system, device class, and specific SCSI hardware. Try any SCSI hardware you want to use and report problems to VMware technical support.

NOTE If you are using generic SCSI devices in a Windows 95, Windows 98, or Windows Me guest operating system and are experiencing problems with the devices, download the latest Mylex (BusLogic) BT/KT-958 compatible host bus adapter from www.lsilogic.com. This driver overrides what Windows chooses as the best driver, but it corrects known problems.

Preparing a Windows XP or Windows Server 2003 Guest Operating System to Use SCSI Devices

To use SCSI devices in a 32-bit Windows XP virtual machine, you need a special SCSI driver available from the download section of the VMware Web site www.vmware.com/download. Follow the instructions on the Web site to install the driver.

Preparing a Windows NT 4.0 Guest Operating System to Use SCSI Devices

Generic SCSI devices use the virtual Mylex (BusLogic) BT/KT-958 compatible host bus adapter provided by the virtual machine. Some guest operating systems guide you through installing the drivers after you install the first SCSI device in the virtual machine. On Windows NT 4.0, you might need to install the driver manually, if it is not already installed for a virtual SCSI disk. Do so before you add a generic SCSI device.

To install the BusLogic driver in a Windows NT 4.0 guest

1 Have your Windows NT installation CD available.

2 Open the SCSI Adapters control panel by choosing:

Start>Settings>Control Panel>SCSI Adapters

3 Click the **Drivers** tab and click **Add**.

4 In the list of vendors on the left, select **BusLogic**.

5 In the list of drivers on the right, select **BusLogic MultiMaster PCI SCSI Host Adapters** and click **OK**.

6 Insert the Windows NT CD when you are prompted and click **OK**.

7 Reboot when you are prompted.

Adding a Generic SCSI Device to a Virtual Machine

The following procedure provides instructions for mapping virtual SCSI devices to physical generic SCSI devices on the host.

To add a generic SCSI device to a virtual machine

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Generic SCSI Device** and click **Next**.

5 From the drop-down list of SCSI devices, choose the one you want to use.

If you do not see the device you want in the list, you might need to add it manually, as described in "Adding a Generic SCSI Device Not Detected by Workstation (Advanced Users)" on page 360.

6 Make sure the **Connect at power on** check box is selected if desired.

7 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

On the **Hardware** tab, in the **Virtual device node** section, select the SCSI device identifier to use for the drive. For example, if you select SCSI 0:2, the guest operating system sees the drive as ID 2 on controller 0.

8 Power on the virtual machine.

NOTE To remove this device, launch the virtual machine settings editor, select the generic SCSI device and click **Remove**.

Adding a Generic SCSI Device Not Detected by Workstation (Advanced Users)

To add a generic SCSI device to a virtual machine, if Workstation does not display the device (for example, scanners on a Windows 2000 host or some tape backup devices), you need to add the device manually to the virtual machine's configuration (`.vmx`) file.

Reasons Workstation cannot detect a device include:

- A driver for that device is not installed on the host.
- A driver on the host prevents the device from being detected.
- The virtual machine uses a device for which there are no drivers available to the host operating system.

Adding a device in this manner is recommended for advanced users only. Before you attempt the procedure described in this section, verify whether the device driver is installed on the host. If the driver is not installed, install it and see if the device appears correctly to Workstation. If it does not appear correctly, or if you cannot or do not want to install the driver on the host, add the device manually to the virtual machine, as described in the procedure that follows.

When adding a device manually to the virtual machine, use `scsiX:Y` notation to refer to the device on the host instead of a device name Workstation uses such as `CdRom0`. For this type of notation, `X` is the SCSI bus on which the device is located on the host and `Y` is the target ID the device uses on the host.

CAUTION Before you add the device, you must disable the original SCSI device driver on the host. Some Windows operating systems do not process the send command from the adapter if the device driver is owning the device.

A few circumstances require you to add or configure the device manually. Follow the directions for the scenario that matches your circumstance. In each case, power off the virtual machine, and open the virtual machine's configuration (`.vmx`) file in a text editor and make the changes described.

Scenario 1: No SCSI Devices

In this case, the virtual machine does not contain any SCSI adapters or devices, or you want to add a generic SCSI device to a new virtual SCSI adapter in the virtual machine.

To add the device to the virtual machine, add the following lines to the virtual machine's configuration file:

```
scsiZ:Y.present = "true"
scsiZ:Y.deviceType = "scsi-passthru"
scsiZ:Y.fileName = "scsiX:Y"
scsiZ.present = "true"
```

Define X, Y, and Z as follows:

- X is the SCSI bus the device uses on the host system.
- Y is the target ID the device uses in the virtual machine and on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- Z is the SCSI bus the device uses in the virtual machine.

Scenario 2: You Want to Use the Existing SCSI Device as a Generic SCSI

In this case, the virtual machine has a SCSI adapter and a SCSI device and you want to use the same device as a generic SCSI device.

To configure the device as a generic SCSI device, add the following lines to the virtual machine's configuration file:

```
scsiZ:Y.deviceType = "scsi-passthru"
scsiZ:Y.fileName = "scsiX:Y"
```

Define X, Y, and Z as follows:

- X is the SCSI bus the device uses on the host system.
- Y is the target ID the device uses in the virtual machine and on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- Z is the SCSI bus the device uses in the virtual machine.

Scenario 3: Workstation Does Not Recognize the Generic SCSI Device

In this case, the virtual machine has a SCSI adapter and generic SCSI device, but Workstation does not recognize the device when the virtual machine is powered on.

Look for a line in the configuration file that looks like:

```
scsiZ:Y.fileName = "<deviceName>"
```

Change the line to:

```
scsiZ:Y.fileName = "scsiX:Y"
```

Define X, Y, and Z as follows:

- X is the SCSI bus the device uses on the host system.
- Y is the target ID the device uses in the virtual machine and on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- Z is the SCSI bus the device uses in the virtual machine.

For example, if the problematic device is a CD-ROM drive, the entry in the configuration file might be:

```
scsi0:4.fileName = "CdRom0"
```

If the device on the host is located on bus 2 with target ID 4, change this line to:

```
scsi0:4.fileName = "scsi2:4"
```

The target ID the device uses in the virtual machine must be the same as the target ID the device uses on the host system.

NOTE The SCSI bus is assigned a number by the host operating system after all IDE buses have been assigned numbers. For example, if you have two IDE buses, they are numbered 0 and 1. The first SCSI bus is assigned bus number 2. In the example above, you use 2 for X.

If you cannot determine the SCSI bus number, try using a third- party tool like `winobj` (which you can download for free from www.sysinternals.com) to determine this information.

The device target ID is usually set by some jumpers or switches on the device. Refer to the owner's manual for the device for information on how to determine the target ID.

Generic SCSI on a Linux Host Operating System

Using the SCSI generic driver in Linux, VMware Workstation allows your guest operating system to operate generic SCSI devices within a virtual machine. The SCSI generic driver sets up a mapping for each SCSI device in `/dev`. Each entry starts with `sg` (for the SCSI generic driver) followed by a letter. For example, `/dev/sg0` is the first generic SCSI device.

Each entry corresponds to a SCSI device in the order specified in `/proc/scsi/scsi`, from the lowest device ID on the lowest adapter to the highest device ID on the highest adapter, and so on to the highest device ID on the highest adapter. Do not enter `/dev/st0` or `/dev/sr0`.

NOTE When setting up a generic SCSI device in the virtual machine settings editor, as described later in this section, specify the device you want to install in the virtual machine by typing its `/dev/sg` entry in the **Connection** field. You must be logged on as a user who has permissions to use the device.

Generic SCSI requires version 2.1.36 or higher of the SCSI Generic (`sg.o`) driver, which comes with kernel 2.2.14 and higher.

Avoiding Concurrent Access to a Generic SCSI Device

Some Linux devices such as tape drives, disk drives, and CD-ROM drives, already have a designated `/dev` entry (`st`, `sd`, and `sr`, respectively). When the SCSI generic driver is installed, Linux identifies these devices with corresponding `sg` entries in `/dev` in addition to their traditional entries. Workstation ensures that multiple programs are not using the same `/dev/sg` entry at the same time but cannot always ensure that multiple programs are not using the `/dev/sg` entry and the traditional `/dev` entry at the same time.

WARNING Do not attempt to use the same generic SCSI device in both host and guest. This can cause unexpected behavior and might cause loss or corruption of data.

Permissions on a Generic SCSI Device

You must have read and write permissions on a given generic SCSI device to use the device within a virtual machine, even if the device is a read-only device such as a CD-ROM drive. These devices typically default to root-only permissions. Your administrator should create a group with access to read and write to these devices and add the appropriate users to that group.

Device Support

In theory, generic SCSI is completely device independent, but VMware has discovered it is sensitive to the guest operating system, device class, and specific SCSI hardware. Try any SCSI hardware and report problems to VMware technical support.

NOTE If you use generic SCSI devices in a Windows 95, 98, or Me guest operating system and are experiencing problems with the devices, download the latest Mylex (BusLogic) BT/KT-958 compatible host bus adapter from www.lsilogic.com. This driver overrides what Windows chooses as the best driver, but it corrects known problems.

To use SCSI devices in a 32-bit Windows XP virtual machine, you need a special SCSI driver available from the download section of the VMware Web site at www.vmware.com/download.

Adding a Generic SCSI Device to a Virtual Machine

The following procedure provides instructions for mapping virtual SCSI devices to physical generic SCSI devices on the host.

To set up a generic SCSI device

1 Start Workstation and select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click **Add** to start the Add Hardware wizard and click **Next**.

4 Select **Generic SCSI Device** and click **Next**.

5 On the Choose SCSI Device page, from the drop-down list of SCSI devices that are available from the host, choose the one you want to use.

6 Make sure the **Connect at power on** check box is selected if desired.

7 Click **Finish** to return to the **Hardware** tab of the virtual machine settings editor.

On the **Hardware** tab, in the **Virtual device node** section, select which SCSI device identifier to use for the drive. For example, if you select SCSI 0:2, the guest operating system sees the drive as ID 2 on controller 0.

8 Power on the virtual machine.

NOTE To remove this device, launch the virtual machine settings editor, select the generic SCSI device and click **Remove**.

Using Two-Way Virtual Symmetric Multiprocessing (Experimental)

For all supported configurations of 32-bit and 64-bit host and guest operating systems running on multiprocessor host machines, Workstation versions 5.5 and higher provide experimental support for two-way virtual Symmetric Multiprocessing (Virtual SMP). This enables you to assign two virtual processors to a virtual machine on any host machine that has at least two logical processors.

The following are all considered to have two or more logical processors:

- A multiprocessor host with two or more physical CPUs
- A single-processor host with a multicore CPU
- A single-processor host with hyperthreading enabled

NOTE On hyperthreaded uniprocessor hosts, performance of virtual machines with Virtual SMP might be subpar.

Guests with more than two virtual processors are not supported in Workstation. However, you can power on and run multiple dual-processor virtual machines concurrently.

The number of virtual processors for a given virtual machine is displayed in the summary view of the virtual machine.You can set the number of processors for the virtual machine in either the New Virtual Machine wizard or the virtual machine settings editor:

- In the virtual machine settings editor: From the Workstation menu bar, choose **VM>Settings**, and on the **Hardware** tab, select **Processors** and specify the number.
- In the New Virtual Machine wizard: Choose to create a custom configuration, and when you come to the Processor Configuration page, specify the number.

If the host is a uniprocessor machine and is not hyperthreaded, assigning two processors is neither supported nor recommended: a warning message will appear. You can disregard this message and assign two processors to the virtual machine, but after you finish creating the virtual machine, you will not be able to power it on unless you move it to a host machine with at least two logical processors.

Virtual machines with SMP are supported only for Workstation versions 5.5 and higher.

Moving SMP Virtual Machines Between Workstation and ESX Server

You can use Workstation 5.5 or later, running on a multiprocessor host machine, to open a virtual machine created in VMware ESX Server that has one or more virtual processors. However, in Workstation you cannot power on a virtual machine that has more than two virtual processors assigned, even if more processors were assigned when the virtual machine was created in ESX Server.

You can see this setting in the virtual machine's summary view or by using the virtual machine settings editor, as follows: From the Workstation menu bar, choose **VM>Settings>Hardware>Processors**, and note that **Number of Processors** is set to **Other (x)**, where **x** is the number of processors originally assigned in ESX Server.

Workstation preserves this original configuration setting for the number of processors, even though two is the maximum number of processors supported. You must change this setting to one or two processors before you can power on the virtual machine in Workstation. After you commit a change to this setting, the original setting for number of processors is discarded and no longer appears as an option in the virtual machine settings editor.

Performance Tuning 16

This chapter offers suggestions for getting the best performance from VMware Workstation and your virtual machines. This chapter contains the following topics:

- "Configuring and Maintaining the Host Computer" on page 367
- "Configuring VMware Workstation and Virtual Machines" on page 370
- "Configuring Guest Operating Systems" on page 379
- "Using the Microsoft Performance Console to Monitor Virtual Machine Performance" on page 386

Configuring and Maintaining the Host Computer

The host computer is an obvious place to look to improve performance. This section discusses these key areas.

CPU

Avoid over-committing the host processors. The performance of virtual machines depends on the capacity of the host machine's processor or processors, and might degrade significantly if you overcommit the processors by running too many virtual machines at the same time.

Memory

Although the minimum required amount of memory is 512MB, VMware recommends at least 2GB of memory for best performance. You must have enough memory to run the host operating system, plus the memory required for each guest operating system and for applications on the host and guest.

Using More Than 1GB of Memory on a Linux Host

By default, Linux kernels in the 2.2.x series support 1GB of physical memory. To use more memory in Linux, take one of several approaches:

- Upgrade to a 2.4.x series kernel that allows for more physical memory.
- Recompile your kernel as a 2GB kernel by using the CONFIG_2GB option.
- Enable the CONFIG_BIGMEM option to map more physical memory, as described later in this section.

CONFIG_2GB Option

The CONFIG_2GB option calls for recompiling your kernel as a 2GB kernel. Recompile your kernel with CONFIG_2GB enabled. This allows Linux to support nearly 2GB of physical memory by dividing the address space into a 2GB user section and a 2GB kernel section (as opposed to the normal division of 3GB for user and 1GB for kernel).

CONFIG_BIGMEM Option

With the CONFIG_BIGMEM option enabled, the kernel does not directly address all of physical memory, and it can then map 1GB (or 2GB) of physical memory into the address space at a time. This allows the use of all of physical memory at the cost of changing the semantics the kernel uses to map virtual to physical addresses. However, VMware products expect physical memory to be mapped directly in the kernel's address space and thus do not normally work properly with the CONFIG_BIGMEM option enabled.

If you are using a 1GB kernel with CONFIG_BIGMEM enabled and have 960MB to 1983MB of memory, Workstation does not run. To work around this issue, you can either:

- Recompile the kernel as a 2GB kernel by enabling the CONFIG_2GB option. This allows for 100 percent use of physical memory.
- Pass the boot-time switch `mem=959M` at the LILO prompt, or add it to `lilo.conf`, to disable CONFIG_BIGMEM and thus allow you to run Workstation. To do this, try one of the following:
  - At the LILO prompt, type `linux-2.2.16xxx mem=959M`.
  - Edit `lilo.conf`. In the kernel section, add this line:

    ```
    append mem="959M"
    ```

If you have a 1GB kernel with CONFIG_BIGMEM enabled and have more than 1983MB of memory, you can do one of the following:

- Recompile the kernel as a 2GB kernel by enabling the CONFIG_2GB option and either pass the boot-time switch `mem=1983M` at the LILO prompt or add it to `lilo.conf`. To use the switch, do one of the following:
  - At the LILO prompt, type `linux-2.2.16xxx mem=1983M`.
  - Edit `lilo.conf`. In the kernel section, add this line:

    ```
    append mem="1983M"
    ```
- Pass the boot-time switch `mem=959M` at the LILO prompt or add it to `lilo.conf` to disable CONFIG_BIGMEM. To use the switch, do one of the following:
  - At the LILO prompt, type `linux-2.2.16xxx mem=959M`.
  - Edit lilo.conf. In the kernel section, add this line:

    ```
    append mem="959M"
    ```

If you are using a 2GB kernel with CONFIG_BIGMEM enabled and have 1984MB or more memory, Workstation does not run. You can either pass the boot-time switch `mem=1983M` at the LILO prompt, or add it to `lilo.conf` to disable CONFIG_BIGMEM and thus allow you to run Workstation. To use the switch, do one of the following:

- At the LILO prompt, type `linux-2.2.16xxx mem=1983M`.
- Edit `lilo.conf`. In the kernel section, add this line:

  ```
  append mem="1983M"
  ```

Disks

For best performance, avoid the situation of very low free space on the host disk. Performance can degrade considerably when Workstation has to use a nearly full host hard disk to do various virtual disk operations such as grow the guest sparse disk, take a snapshot, or append to redo files.

Enabling Host Disk Caching on Microsoft Windows Hosts

On Windows hosts, the Disk Properties Policies page associated with each hard drive provides a check box for enabling write caching on the disk and, in some cases, enabling advanced performance on the disk. Checking one or both of these boxes can improve host disk performance in general. Checking them for the host disks containing VMware virtual disk files can improve VMware disk performance in particular, especially when VMware is making heavy use of the disk. The following procedure provides instructions for using these settings on a Windows XP host.

To enable write caching on a Windows XP host

1 On the host computer's desktop open **My Computer**.

2 Right-click the hard disk and choose **Properties** from the menu that appears.

3 On the **Hardware** tab, select the hard drive and click the **Properties** button.

4 On the **Policies** tab, select **Enable write caching on the disk**, and, optionally, select **Optimize for performance**.

5 Click **OK**.

WARNING Power outage or equipment failure can result in data loss or corruption with this option enabled.

Networking

If your system has multiple physical network interface cards (NICs), either built-in or in PCI slots, to make sure that you are using the intended NIC, try disabling the other NICs.

Increasing NIC Interrupt Coalescing

Increasing host NIC interrupt coalescing can improve performance for workloads involving heavy network traffic into the guest. Interrupt coalescing is a feature implemented in hardware under driver control on high-performance NICs. Interrupt coalescing allows the operating system kernel to be notified of the reception of a group of network frames through a single hardware interrupt.

Configuring VMware Workstation and Virtual Machines

This section offers advice and information about factors that can affect the performance of Workstation and virtual machines. It lists configuration settings you make by using Workstation rather than by using operating system tools in the host or guest.

NOTE In addition to the Workstation configuration options discussed in this section, always install VMware Tools in any guest operating system for which a VMware Tools package exists. Installing VMware Tools provides better video and mouse performance and also greatly improves the usability of the virtual machine. For details, see "Installing and Upgrading VMware Tools" on page 113.

CPU

This section includes the following topics:

- "Disconnecting the CD-ROM" on page 371
- "Configuring Process Scheduling on Windows Hosts" on page 371

Disconnecting the CD-ROM

Disconnecting CD-ROM devices reduces CPU usage. Configure your virtual CD-ROM drive to start disconnected. The drive appears in the virtual machine, but it always appears to contain no disk (and Workstation does not connect to your host CD-ROM drive).

To use a CD-ROM in the virtual machine, choose **VM>Removable Devices**, and connect the CD-ROM drive.

To configure the virtual CD-ROM to start disconnected

1 Select the virtual machine.

The virtual machine can be powered on or off.

2 Choose **VM>Settings>Hardware>DVD/CD-ROM**.

3 In the CD-ROM settings panel, deselect the **Connect at power on** check box and click **OK**.

You can also use the **VM>Removable Devices** menu to disconnect your CD-ROM drive if you do not need to use it.

Configuring Process Scheduling on Windows Hosts

By default, the processes within a virtual machine contend equally for resources with all other processes running on the host, regardless of whether or not the mouse and keyboard are grabbed by the virtual machine.

Workstation on a Windows host provides configuration options that let you adjust scheduling priorities to meet your needs. These configuration options are available:

- On a global basis, for all virtual machines. Use the Workstation preference editor, as follows: From the Workstation menu bar, choose the **Edit>Preferences** and click the **Priority** tab.
- On a per-virtual-machine basis, for virtual machines on which you want to override the default global setting. Use the virtual machine settings editor, as follows: Select the virtual machine, and from the Workstation menu bar, choose **VM>Settings**. On the **Options** tab, select **Advanced**.

These menu items allow you to specify either high or normal priority when the mouse and keyboard are grabbed by the virtual machine and either normal or low priority when they are not grabbed. By default, the priority for virtual machine processing is set to **Normal** for both input grabbed and input ungrabbed.

If you have many background processes or applications and you do not care whether they run with fairly low relative priority while Workstation is in the foreground, set **Input grabbed** to **High**, and set **Input ungrabbed** to **Normal**. You should see a noticeable performance boost when using one virtual machine while another virtual machine is running or while some other processor-intensive task (a compile, for example) is running in the background.

Conversely, if your host machine runs too sluggishly when a virtual machine is running in the background, you can direct the virtual machine to drop its priority when it does not have control of the mouse and keyboard. Set **Input grabbed** to **Normal**, and set **Input ungrabbed** to **Low**.

Memory

VMware Workstation allows you to adjust the following memory-related settings:

- Memory size of a particular virtual machine.
- Amount of the host computer's RAM that can be used for all virtual machines combined.
- Extent to which you want to allow the host operating system's memory manager to swap virtual machines out of physical RAM.

By adjusting these three settings, you can affect both virtual machine and overall system performance.

Setting the Memory Size of a Virtual Machine

The first configuration parameter you can set is the size of an individual virtual machine's memory. The guest memory size should not be set lower than the minimum recommendations of the operating system provider.

You can specify the amount of memory for a virtual machine either when you create it, by using the New Virtual Machine wizard, or after you create it, by using the virtual machine settings editor:

- In the virtual machine settings editor: From the Workstation menu bar, choose **VM>Settings**, and on the **Hardware** tab, select **Memory** and specify the number.
- In the New Virtual Machine wizard: Choose to create a custom configuration, and when you come to the Memory for the Virtual Machine page, specify the number.

The typical configuration used by the New Virtual Machine wizard sets reasonable defaults for the memory, based on the type of the guest operating system and the amount of memory in the host computer. This value also appears in the virtual machine settings editor as the recommended memory value.

The virtual machine settings editor also shows a value for the maximum amount of memory for best performance. If you have only one virtual machine running on the host and you set virtual machine memory to this value, the virtual machine can run entirely in RAM. A virtual machine running completely in RAM performs better than a virtual machine that must swap some of its memory to disk.

The actual memory size you should give to a virtual machine depends on a few considerations:

- The kinds of applications that will run in the virtual machine.
- Other virtual machines that will contend with this virtual machine for memory resources.
- Applications that will run on the host at the same time as the virtual machine.

NOTE You cannot allocate more than 2GB of memory to a virtual machine when the virtual machine's files are stored on a host file system that does not support files greater than 2GB. For example, this restriction applies to FAT file systems.

As of version 6.0 of Workstation, the total amount of memory you can assign to all virtual machines running on a single host is unlimited. The maximum amount of memory per virtual machine is 8GB.

Reserving Memory for Workstation

Host operating systems do not behave well when they run low on free memory for their own use. When a Windows or Linux host operating system does not have enough RAM for its own use, it thrashes. That is, it constantly swaps data between RAM and its paging file on disk.

The second configuration parameter you can set is the maximum amount of RAM that Workstation is allowed to reserve for all running virtual machines combined. To set this parameter, from the Workstation menu bar, choose the **Edit>Preferences** and click the **Memory** tab. The RAM used by Workstation includes the RAM made available to the guest operating systems plus a small amount of overhead memory associated with running a virtual machine.

To help guard against having virtual machines cause the host to thrash, Workstation enforces a limit on the total amount of RAM that can be consumed by virtual machines. Some memory must be kept available on the host to ensure the host is able to operate

properly while virtual machines are running. The amount of memory reserved for the host depends on the host operating system and the size of the host computer's memory.

Specifying the Amount of Memory That Can Be Swapped to Disk

By default, Workstation limits the number of virtual machines that can run at once based on the amount of memory specified in the application settings. This prevents virtual machines from causing each other to perform poorly.

To allow more or larger virtual machines to run, adjust a third setting: the amount of virtual machine memory that the host operating system can swap to disk. To change this setting, choose the **Edit>Preferences**, click the **Memory** tab, and select one of the following radio buttons:

- **Fit all virtual machine memory into reserved host RAM** – Strictly apply the reserved memory limit set in the top of the panel. This setting imposes the tightest restrictions on the number and memory size of virtual machines that can run at a given time. Because the virtual machines are running entirely in RAM, they have the best possible performance.
- **Allow some virtual machine memory to be swapped** – Allow the host operating system to swap a moderate amount of virtual machine memory to disk if necessary. This setting allows you to increase the number or memory size of virtual machines that can run on the host computer at a given time. Unfortunately, it might also result in reduced performance if virtual machine memory must be shifted between RAM and disk.
- **Allow most virtual machine memory to be swapped** – This option can result in lower performance than the other options. It allows the host operating system to swap as much virtual machine memory to disk as it wants. This setting allows you to run even more virtual machines with even more memory than the intermediate setting does.

Disabling Memory Trimming

Workstation uses a memory trimming technique to return unused virtual machine memory to the host machine for other uses. Although memory trimming usually has little impact on performance and might be needed in low-memory situations, the I/O caused by memory trimming can sometimes interfere with disk-oriented workload performance in a guest.

You can disable memory trimming for a guest in the virtual machine settings editor (from the Workstation menu bar, choose **VM>Settings>Options>Advanced**). In the **Settings** section, select **Disable memory page trimming**.

Disabling Page Sharing

VMware uses a page sharing technique to allow guest memory pages with identical contents to be stored as a single copy-on-write page. Many workloads present opportunities for sharing memory across virtual machines. For example, several virtual machines might be running instances of the same guest operating system, have the same applications or components loaded, or contain common data.

With memory sharing, a workload often consumes less memory than it would when running on a physical machine. As a result, the system can support higher levels of overcommitment efficiently.

The amount of memory saved by memory sharing is highly dependent on workload characteristics. A workload that consists of many nearly identical virtual machines might free up more than 30 percent of memory, whereas a more diverse workload might result in savings of less than 5 percent of memory.

Workstation memory sharing runs as a background activity that scans for sharing opportunities over time. For a fairly constant workload, the amount of memory saved generally increases slowly until all sharing opportunities are exploited.

Although page sharing decreases host memory usage, it does consume system resources, potentially including I/O bandwidth. You might want to avoid this overhead for guests for which host memory is plentiful and I/O latency is important. To disable page sharing, add the following line to the virtual machine configuration (`.vmx`) file:

```
sched.mem.pshare.enable = "FALSE"
```

Disks

This section includes the following topics:

- "Avoiding Remote Disk Access" on page 375
- "Using SCSI Disks Rather Than IDE Disks" on page 376
- "Removing Snapshots" on page 376
- "Using Persistent Mode" on page 376

Avoiding Remote Disk Access

VMware recommends placing virtual disks on local hard drives for optimal performance. If you must access virtual disks over the network, use the fastest available network connection. Also try the strategy described in the following procedure.

To use virtual hard disks stored on a remote machine

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 From the Workstation menu bar, choose **VM>Settings>Options**.

3 Select **General** and set the working directory to a directory on your local hard disk.

4 Then take a snapshot.

After you take the snapshot, changes you make are stored locally in the working directory.

Using SCSI Disks Rather Than IDE Disks

When you create a virtual disk, either by using the New Virtual Machine wizard or by using the Add New Hardware wizard, you must choose a disk type, which can be either SCSI or IDE. Virtual SCSI disks perform better than virtual IDE disks. The default disk type selected in the wizard is usually SCSI.

The default depends on the operating system of the virtual machine, however. To use a SCSI disk, the guest operating system must have a driver for the LSI Logic or BusLogic SCSI adapter available in the virtual machine. You choose which SCSI adapter to use at the time you create the virtual machine.

To use SCSI disks in a 32-bit Windows XP virtual machine, you need a special SCSI driver that is not available in the virtual machine. It is available from the download section of the VMware Web site at www.vmware.com/download. Follow the instructions on the Web site to use the driver with a fresh installation of Windows XP.

Removing Snapshots

If you do not use the snapshot feature, run your virtual machine with no snapshot. This provides best performance. To be sure a virtual machine has no snapshot, from the Workstation menu bar, choose **VM>Snapshot>Snapshot Manager**. If you see a snapshot you do not want, select it and click the **Delete** button.

Using Persistent Mode

Normally, virtual disks are configured so that if you take a snapshot, data on the disk is recorded in the snapshot. You can, however, make the disk independent, so that snapshots do not include disk information. An independent disk can be persistent or nonpersistent. With persistent disks, changes are immediately and permanently written to the disk. Independent, persistent disks have better performance than disks whose data is recorded in snapshots.

To set a virtual disk to use independent, persistent mode

1 Select the virtual machine.

Make sure the virtual machine is powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Select **Hard Disk** and click **Advanced**.

The Advanced dialog box opens.

4 In the **Mode** section, select the **Independent** check box and select **Persistent**.

5 Click **OK** in both the Advanced dialog box and the virtual machine settings editor.

Networking

If you plan to often copy large files between the host and guest, you might find that using bridged networking results in better performance than using NAT. For a discussion of the network strategies, see "Network Basics" on page 272.

Additional Suggestions for Improving Performance

This section includes the following topics:

- "Selecting the Correct Guest Operating System" on page 377
- "Turning Off Debugging Mode" on page 378
- "Logging Virtual Machine Progress Periodically" on page 379

Selecting the Correct Guest Operating System

Make certain you select the correct guest operating system for each of your virtual machines. To check the guest operating system setting, from the Workstation menu bar, choose **VM>Settings>Options>General**.

Workstation optimizes certain internal configurations on the basis of this selection. For this reason, it is important to set the guest operating system correctly. The optimizations can greatly aid the operating system they target, but they can cause significant performance degradation if there is a mismatch between the selection and the operating system actually running in the virtual machine. (Selecting the wrong guest operating system should not cause a virtual machine to run incorrectly, but it might degrade the virtual machine's performance.)

Turning Off Debugging Mode

Workstation has three modes for collecting debugging information: normal mode (which means that no debugging information is gathered), statistics mode, and full debugging mode. In normal mode, the virtual machine runs faster than in the other modes. As of the Workstation 6 release, you do not need to restart the virtual machine after changing the debugging mode.

For normal use, make sure you are not running in debugging mode, as described in the procedure in this section.

NOTE If you turn on the record/replay feature, by enabling the **Enable execution record and replay** check box (**VM>Settings>Options>Snapshot/Replay**), the debugging mode automatically gets set to **Full**. If you later disable record/replay, you need to manually set debugging mode back to **Normal**.

You might need to use one of the other modes under the following conditions:

- If the virtual machine sometimes crashes and you want to determine the cause, use full debugging mode so that you can send the debugging logs to VMware technical support.
- If, in normal mode, the virtual machine runs extremely slowly under some workloads, and you want to determine the cause, use statistics mode so that you can send the statistics file to VMware technical support.

After you generate some debugging information, run the `vm-support` script, as described in "Reporting Problems" on page 17, and send the output to VMware technical support.

When the cause and remedy for an issue have been found, return to normal mode.

To set a debugging mode

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Advanced**.

4 In the **Settings** section, set the **Gather debugging information** control to the desired mode and click **OK**.

These modes were described at the beginning of this section.

You do not need to restart the virtual machine for the new debugging level to take effect.

Logging Virtual Machine Progress Periodically

For best performance, you will usually not run Workstation in full debugging mode. Even if you encounter an issue that requires troubleshooting, you might not need to enable debugging mode. Instead, first, try the following procedure to increase the amount of logging information collected.

To log progress periodically

1 Start Workstation and select the virtual machine.

The virtual machine can be either powered on or powered off.

2 Choose **VM>Settings**.

The virtual machine settings editor opens.

3 Click the **Options** tab, and select **Advanced**.

4 In the **Settings** section, select the check box called **Log virtual machine progress periodically** and click **OK**.

Configuring Guest Operating Systems

The tips in this section help you make adjustments to improve performance for particular guest operating systems running inside a virtual machine.

CPU

Avoid CD-ROM drive polling on older systems. Some operating systems, including Windows NT and Windows 98, poll the CD-ROM drive every second or so to see whether a disk is present. (This allows them to run autorun programs.) This polling can cause Workstation to connect to the host CD-ROM drive, which can make it spin up while the virtual machine appears to pause.

If you have a CD-ROM drive that takes an especially long time to spin up, eliminate these pauses by disabling the polling inside your guest operating system. The method varies by operating system. For recent Microsoft Windows operating systems, the easiest way is to use TweakUI from the PowerToys utilities. For information on finding TweakUI and installing it in your guest operating system, go to www.microsoft.com and search for TweakUI.

Disks

This section includes the following topics:

- "Turning on DMA Mode for IDE Disks" on page 380
- "Defragmenting Disk Drives" on page 382

Turning on DMA Mode for IDE Disks

The disk options (SCSI or IDE) and types (virtual or physical) affect performance in many ways. Inside a virtual machine, SCSI disks and IDE disks that use direct memory access (DMA) have approximately the same performance. However, IDE disks can be very slow in a guest operating system that either cannot use or is not set to use DMA.

The easiest way to configure a Linux guest to use DMA for IDE drive access is to install VMware Tools (see "Installing VMware Tools on a Linux Guest" on page 123). Among other things, the installation process sets IDE virtual drives to use DMA.

In newer versions of Windows, DMA access is enabled by default. In older Windows guest operating systems, the method for changing the setting varies with the operating system. See the following sections for details:

- "Turning on DMA Mode for Windows 95/98 Guests with IDE Disks" on page 380
- "Turning on DMA Mode for Windows NT Guests with IDE Disks" on page 381

Turning on DMA Mode for Windows 95/98 Guests with IDE Disks

Windows 95 OSR2 and later (including Windows 98) can use direct memory access (DMA) for faster access to IDE hard disks. However, this feature might not be enabled by default.

You can turn on DMA access by using the guest operating system's Device Manager.

To turn on DMA access

1 On the guest operating system's desktop, right-click **My Computer**, and choose **Properties** from the menu.

2 Click the **+** sign beside **Disk Drives** to show your virtual machine's individual drives.

3 Right-click the entry for each IDE drive to open its Properties dialog box.

4 Under **Settings**, select the **DMA** check box and accept any warning Windows displays.

5 Restart Windows for the new settings to take effect.

Turning on DMA Mode for Windows NT Guests with IDE Disks

Some users have seen a problem in a Workstation virtual machine that uses IDE virtual disks on a multiprocessor host computer. The I/O issue is especially noticeable when the virtual machine is booting.

You might improve performance by enabling DMA (direct memory access) on the virtual hard disk's IDE channel in the virtual machine.

If you have a virtual disk and a DVD/CD-ROM attached as master and slave to the primary IDE controller (channel 0) and you want to enable DMA, power off the virtual machine, and use the virtual machine settings editor (from the Workstation menu bar, choose **VM>Settings>CD-ROM**) to move the DVD/CD-ROM drive to the secondary IDE controller (channel 1) at IDE 1:0.

You can enable the DMA feature after you finish installing Windows NT. You must install Service Pack 6a. Download `DMACHECK.EXE` from the Microsoft Web site (support.microsoft.com/support/kb/articles/Q191/7/74.ASP) and run it.

When you run `DMACHECK.EXE`, click the **Enabled** option for the IDE controller and channel configured for the virtual disk. Typically, this is channel 0 only, unless you have the virtual machine configured with multiple virtual disks and no virtual DVD/CD-ROM drive.

Do not enable DMA on an IDE channel with a virtual DVD/CD-ROM drive attached.

Defragmenting Disk Drives

Defragment virtual disks and host disks in the following phases, from inside the guest operating system out to the host operating system, as follows:

1 **Defragment by using a guest operating system utility** – For example, in a virtual machine with a Windows XP guest operating system, use the Windows XP Disk Defragmenter tool from within the virtual machine.

   For the following reasons, VMware strongly recommends that you defragment by using a guest operating system mechanism before taking the first snapshot (or linked clone):

   - Workstation makes all its changes to the redo log, not to the original disk, when you run a defragmenting program on the guest after a snapshot. You lose the ability to defragment inside the original disk forever.
   - Every sector that moves is copied to the redo log, making the virtual machine redo log extremely large when the disk is heavily fragmented and you run defragmentation after a snapshot.

2 **Defragment the virtual disk by using the Workstation defragmentation tool** – If the disk is a "growable" disk, not one whose disk space was preallocated at the time when you created the virtual machine, also use Workstation to defragment the virtual disk. For instructions, see "Defragmenting Virtual Disks" on page 199.

3 **Defragment the host disks** – Use a defragmentation utility for the host's operating system. For example, if the host's operating system is Windows Vista, use the Windows Vista Disk Defragmenter tool.

   Performance is weakened by fragmentation on the physical disk that holds the virtual machine's working directory or virtual disk files. Fragmentation of the host disk can affect any or all of the following:

   - Virtual disk files
   - Files that store newly saved data when you have a snapshot
   - Files that hold information used in suspending and resuming a virtual machine

   If you are experiencing slow disk performance in the virtual machine, or if you want to improve the speed of suspend and resume operations, find out whether the host disk is fragmented. If it is, you can improve performance by running a defragmentation utility.

Performance Impact of Defragmenting Snapshots and Linked Clones

There might be a performance impact when you defragment a linked clone or a virtual machine with a snapshot. Exact performance degradation depends on:

- The fragmentation of the parent virtual machine disk when you created the snapshot or linked clone.
- The nature of the subsequent updates to the parent virtual machine disk.

The redo file itself can become defragmented with respect to the host file system. If your use of virtual machines is strongly performance oriented, you should avoid defragmenting—or using—linked clones and snapshots.

Networking

Make sure VMware Tools is installed. VMware Tools includes many device drivers that improve performance of graphics displays, mouse operations, and network operations. For installation instructions, see "Installing and Upgrading VMware Tools" on page 113.

Visual Effects (Windows Only)

On Microsoft Windows systems, some users have seen performance improvements when they turn off visual effects. An example of such a visual effect is the fade effect that Windows 2000, Windows XP, and Windows Server 2003 use when displaying menus.

To turn off visual effects

Depending on which operating system you use:

- On Windows 98:
  a. Right-click on the desktop of your virtual machine, and choose **Properties** from the menu that appears.
  b. Click the **Effects** tab and deselect the **Animate windows, menus, and lists** check box.
  c. If you have **Show window contents while dragging** selected, deselect that check box.
- On Windows 2000:
  a. Right-click the guest operating system desktop, and choose **Properties>Effects**.
  b. Deselect **Use transition effects for menus and tool tips**.
- On Windows XP and Windows Server 2003:
  a. Right-click the guest operating system desktop, and choose **Properties>Appearance>Effects**.
  b. Deselect **Use transition effects for menus and tool tips**.
- On Windows Vista:
  a. Use the Control Panel's Performance Information and Tools item (in Classic view).
  b. Click the link called **Adjust visual effects**.

Enhanced Performance with Paravirtualized Kernels in Linux Guests

Since 2005, VMware has been collaborating with the Linux community to develop a common paravirtualization interface. In 2006, VMware released its VMI specification as an open specification. For more information on paravirtualization in general, see the following VMware Web site:

http://www.vmware.com/interfaces/paravirtualization.html

If you have a VMware VMI (Virtual Machine Interface) enabled kernel in the guest operating system, you will see improved performance if you enable paravirtual support in the virtual machine.

NOTE Use the following procedure to get and enable a paravirtualized kernel.

To use paravirtualized kernels

1 To get a VMI-enabled kernel, download the CD image of Ubuntu 7.04 (Feisty) or later from:

http://www.ubuntu.com/getubuntu/download

Use the standard image for 32-bit Intel x86 computers. VMI is currently 32-bit only.

2 Use Workstation's New Virtual Machine wizard to create a Workstation 6 virtual machine with the guest operating system type **Ubuntu**.

For step-by-step instructions, see "Using the New Virtual Machine Wizard" on page 92. Make sure the hardware version is Workstation 6.

3 After you finish creating the virtual machine, enable paravirtual kernel support, as follows:

a From the Workstation menu bar, choose **VM>Settings**.

The virtual machine settings editor opens.

b On the **Options** tab, click **Advanced**, and in the **Settings** section, select the check box called **Enable VMware paravirtual kernel support**.

Do not close the virtual machine settings editor yet.

4 Set the virtual machine to use the ISO image you downloaded in step 1:

a On the **Hardware** tab, select **CD-ROM**, and in the **Connection** section, select **Use ISO image**.

b Browse to and select the ISO image you downloaded in step 1.

c Click **OK** to save your settings and close the virtual machine settings editor.

5 Power on the virtual machine and install the Linux operating system from the ISO file.

Using the Microsoft Performance Console to Monitor Virtual Machine Performance

VMware Workstation incorporates a set of performance counters that work with Microsoft's Performance console so you can collect performance data from running virtual machines.

NOTE The Performance console is available only on Windows hosts. You can monitor the performance of any virtual machines running on the Windows host, including those running Linux guest operating systems.

On Linux hosts, there is no specific application that Workstation is designed to work with to provide additional VMware-specific statistics.

Workstation performance counters can monitor the following data from a running virtual machine:

- Reading and writing to virtual disks
- Memory used by the virtual machine
- Virtual network traffic

You can track virtual machine performance only when a virtual machine is running. Performance counters reflect the state of the virtual machine, not the guest operating system. For example, the counters can record how often a virtual machine reads from a virtual disk, but they cannot track how many processes are running inside the guest operating system. An explanation of each counter appears in the Performance console.

To add counters to track virtual machine performance

1 Open the Administrative Tools control panel and double-click **Performance**.

The Performance console opens.

2 Click the plus (+) sign on the toolbar.

The Add Counters dialog box appears.

3 From the Performance object list, select **VMware**.

4 Specify whether to add all counters or select specific counters from the list.

If you select **Select counters from the list**, also click **Add** to display the information in the Performance console.

NOTE For a brief description of each counter, click **Explain**. When you select a counter from the list, a description appears below the Add Counters dialog box.

---

5 Specify whether to view information for all virtual machines or specific ones.

For specific virtual machines, select **Select instances from list**, and choose the virtual machines you want. The names shown in the list correspond to the display names of running virtual machines.

For more information about using the Performance console, from the Performance console menu bar, choose **Action>Help**, or go to the Microsoft Web site.

Special-Purpose Configuration Options for Windows Hosts

17

This chapter describes how to use configuration options for such things as restricting the operations a user can perform with a virtual machine or simplifying the user interface for inexperienced users. In a classroom, for example, you can ensure that virtual machine configurations remain consistent from one class session to the next.

This chapter includes the following topics:

- "Locking Out Interface Features (Windows Hosts Only)" on page 389
- "Restricting the User Interface" on page 390
- "Using Full Screen Switch Mode" on page 393
- "Guest ACPI S1 Sleep" on page 401

Locking Out Interface Features (Windows Hosts Only)

Administrative lockout is a global setting that affects all virtual machines for all users on a host computer. It allows you to configure settings so that only a user who knows the password can perform one or more of the following tasks:

- Create new virtual machines.
- Edit virtual machine configurations.
- Edit network settings.

If no user has set administrative lockout preferences, any user can set them and set a password for access to the administrative lockout features. If any user has already set administrative lockout preferences, you must know the password in order to change the settings.

To set administrative lockout preferences

1 From the Workstation menu bar, choose **Edit>Preferences**.

2 Click the **Lockout** tab and if a password is already set for the administrative lockout feature, enter the password when prompted.

3 Select the **Enable** check box, and select the actions you want to restrict.

If this is the first time administrative lockout options are being set, specify a password in the fields provided.

4 Click **OK** to save the settings.

Removing a Forgotten Password

If you cannot remember the password and want to remove it, you must uninstall Workstation. Be sure to click **Yes** when asked if you want to remove the administrative lockout settings. After you reinstall Workstation, you can enable the administrative lockout features again and set a new password.

Restricting the User Interface

The restricted user interface affects only the specific virtual machines for which the setting is made. The following changes are made when you enable the restricted user interface:

- The toolbar is always hidden.
- All functions on the **VM>Power** menu are disabled.
- All functions on the **VM>Snapshot** menu and snapshot functions on the toolbar are disabled.
- There is no access to the virtual machine settings editor (**VM>Settings**) from the VMware Workstation window.
- The user cannot change virtual networking settings (**Edit>Virtual Network Settings**).
- The user starts the virtual machine by double-clicking the configuration file (`.vmx` file) or a desktop shortcut to that file. The virtual machine powers on automatically. At the end of the working session, the user shuts down by closing the virtual machine (**File>Exit**).

  It is also possible to launch Workstation and open a restricted-interface virtual machine from the virtual machine list or the **File** menu.

The changes needed to enable the restricted user interface must be made by a user with sufficient privileges to edit the virtual machine's configuration file and to set file permissions as described in the following procedure.

To enable the restricted user interface

1 Power off the virtual machine and close the VMware Workstation window.

2 Open the virtual machine's configuration file (`.vmx` file) in Notepad or another text editor.

3 Add the following line anywhere in the file:

```
gui.restricted = "TRUE"
```

4 Optionally, set file permissions on the configuration file to give normal users of the system only read access to the file, so they cannot manually modify the configuration.

5 Create a shortcut to the configuration file on the desktop and give it an appropriate name.

NOTE Although the restricted user interface provides no access to menu and toolbar controls for the snapshot, you can give users limited snapshot control. If you set up a snapshot for the restricted virtual machine and set the power-off option to **Ask Me**, the user sees the standard dialog box when shutting down a virtual machine and has the opportunity to choose **Just Power Off**, **Take Snapshot**, or **Revert to Snapshot**.

Automatically Returning to a Snapshot with a Restricted User Interface

You can combine a restricted user interface with a snapshot to ensure that users' virtual machines always start in the same state. Typically, users running a virtual machine with a restricted user interface can power it on and off only, and the virtual machine boots when powered on. When the virtual machine has a snapshot set and is configured to return to that snapshot when powered off, the user can only start and power off the virtual machine. The virtual machine always starts from the snapshot.

To set up a virtual machine with a restricted user interface (Windows only)

1 Power on the virtual machine and be sure it is in the state you want.

2 Create a snapshot.

For instructions, see "Taking a Snapshot" on page 233.

3 Configure the virtual machine to return to the snapshot any time it is powered off: Choose **VM>Settings>Options>Snapshots** and select **After Powering Off** and **Revert to Snapshot**.

4 With the virtual machine powered off, restrict the user interface, as follows:

   a Close the VMware Workstation window.

   b Open the virtual machine's configuration file (`.vmx` file) in Notepad or another text editor.

   c Add the following line anywhere in the file.

   ```
   gui.restricted = "TRUE"
   ```

5 Optionally, set file permissions on the configuration file to give normal users of the system only read access to the file, so they cannot manually modify the configuration.

6 Create a shortcut to the configuration file on the desktop and give it an appropriate name.

Users run this virtual machine by double-clicking the shortcut to the configuration file. It starts at the snapshot, with the user interface restricted. Users do not have a toolbar or access to the **VM>Power** menu or the virtual machine settings editor.

Users close the virtual machine by choosing **File>Close**. The virtual machine powers off, and the next time a user powers it on, it returns to the snapshot.

To remove the restriction on the interface

1 Power off the virtual machine and close the VMware Workstation window.

2 Open the configuration file (`.vmx`) file and do one of the following:

- Set `gui.restricted = "FALSE"`.
- Remove or comment out the `gui.restricted = "TRUE"` line.

3 Save the changes to the configuration file and close it.

4 Start the virtual machine by double-clicking the shortcut.

   The virtual machine starts at the snapshot, and the interface is not restricted.

Using Full Screen Switch Mode

Full screen switch mode is a run-time option for the VMware Workstation program on Windows hosts. When Workstation is running in full screen switch mode, the user has no access to the Workstation user interface. The user cannot create, reconfigure, or launch virtual machines. A system administrator performs these functions.

When Workstation is running in full screen switch mode, one or more virtual machines can be running, and you can use hot keys to switch from one to another. You can also provide hot key access to the host operating system.

NOTE Full screen switch mode is enabled for Windows hosts only. Linux hosts do not have full screen switch mode.

Creating a Virtual Machine for Use in Full Screen Switch Mode

To create new virtual machines, run Workstation in standard mode. The instructions in this section assume that you are creating the virtual machines on a separate administrative computer. If you prefer, create the virtual machines directly on the user's computer.

To create a virtual machine that will be used in full screen switch mode

1 Create the new virtual machine following the instructions in "Setting Up a New Virtual Machine" on page 87.

As you complete the New Virtual Machine wizard, make the following choices:

- In Step 3, "In the Select the Appropriate Configuration page, select Typical and click Next.," on page 93, select **Custom** to perform a custom installation.
- In Step 5, "On the Name the Virtual Machine page, select a name and folder for the virtual machine and click Next.," on page 93, make a note of the folder in which you create the virtual machine. You must copy all the files in this folder to the user's computer after you finish creating and configuring the virtual machine.
- In Step 7, "On the Specify Disk Capacity page, enter the size of the virtual disk, specify the way you want the disk space allocated, and click Finish.," on page 93, specify the size for the virtual disk and select **Allocate all disk space now**. This selection is strongly recommended. If you do not make this selection and the host computer's hard disk runs out of space for a growing virtual disk file, the user sees no warning message and does not know what is causing the problem in the virtual machine.

2 To open the virtual machine settings editor, select the virtual machine and choose **VM>Settings**.

3 Use the virtual machine settings editor to make all needed configuration settings before you configure the user's computer to launch Workstation when the computer starts.

NOTE If you plan to run the virtual machine on a laptop computer, be sure to set the virtual machine to report the battery status, as described in "Reporting Battery Information in the Guest Operating System" on page 158.

You cannot change virtual machine settings by using the virtual machine settings editor when Workstation is running in full screen switch mode. It is recommended that you finish configuring the virtual machine and install the guest operating system and applications before you move the virtual machine to the user's computer.

Moving a Virtual Machine to the User's Computer

The easiest way to move the virtual machine to a user's computer is to use a network connection to copy all the files in the virtual machine directory to a directory on the user's computer. You can also move the directory by using a DVD or other removable media large enough to store the files.

Place each virtual machine in its own separate directory.

Setting Configuration Options on the User's Computer

This section describes the local and global configuration settings you can use.

Global Configuration Settings

Global configuration settings are made in the Workstation global configuration file, created by default in the following locations:

- On a Windows host:

  ```
  C:\Documents and Settings\All Users\Application Data\VMware\VMware
  Workstation\config.ini
  ```

- On a Linux host:

  ```
  /etc/vmware/config
  ```

Full screen switch mode is enabled for Windows hosts only. This Linux configuration file path is provided for clarity and completeness.

You can edit this file with a text editor. Set permissions on this file so that the user cannot change it.

Local Configuration Settings

Local configuration settings are made in the configuration file for a particular virtual machine. The local configuration file is in the virtual machine's directory. The filename has a `.vmx` extension.

The format for an entry in either configuration file is:

```
<option> = "<value>"
```

Entries in the configuration files can appear in any order.

The hot key entries described in this section require you to enter a virtual key code as part of the value for an option. Virtual key codes use hexadecimal format, which is a hexadecimal number preceded by 0x. For example, to use the virtual key code of 5A as a value, type **`0x5A`**.

Microsoft provides a reference list of virtual key codes on the MSDN Web site. At the time this manual was written, the reference list was at:

http://msdn2.microsoft.com/en-us/library/ms645540.aspx

The hot-key entries also include modifier keys. The modifier keys are Ctrl, Alt, Shift, and Windows keys. The Windows key is the key between the Ctrl and Alt keys on your keyboard. You can also use a combination of those keys. See Table 17-1 for a list of the key codes for the modifier keys.

Table 17-1. Modifier Keys for Hot Key Entries

Modifier Key	Value
No modifier	0x0
Alt	0x1
Ctrl	0x2
Shift	0x4
Win (Windows)	0x8
Ctrl+Alt	0x3
Alt+Shift	0x5
Ctrl+Shift	0x6
Ctrl+Alt+Shift	0x7
Win+Alt	0x9

Table 17-1. Modifier Keys for Hot Key Entries (Continued)

Modifier Key	Value
Win+Ctrl	0xa
Win+Ctrl+Alt	0xb
Win+Shift	0xc
Win+Shift+Alt	0xd
Win+Shift+Ctrl	0xe
Win+Shift+Ctrl+Alt	0xf

When listing a key plus a modifier, type the virtual key code for the key followed by a comma, and type the value for the modifier key or keys. For example, the value entry for Ctrl+Shift+F1 is `0x70,0x6`.

NOTE Keep the following limitations in mind when defining cycle keys and switch keys:

- Do not use the Pause key with the Ctrl key. You can use the Pause key with other modifier keys.
- If you use F12, you must use one or more modifier keys. You cannot use F12 alone.
- You cannot use combinations that include only the Shift, Ctrl, and Alt keys. These keys can be used only as modifiers in combination with some other key.

Hot Key for Cycling Through Virtual Machines and the Host Computer

You can specify a hot key or hot-key combination for cycling through the available virtual machines on a host computer. Hot keys behave in the following manner:

- Each time you press the specified hot key, the screen displays the next virtual machine in order. You can also include the host operating system in the cycle.
- If any particular virtual machine is not running, it is skipped.
- If only one virtual machine is running and the host operating system is not included in the cycle, pressing the hot key has no effect.

The hot key for cycling through virtual machines is defined in the global configuration file (`config.ini`). Two options control cycling:

- `FullScreenSwitch.cycleKey`

  The value of this option defines the hot key. It is specified as `<key>,<modifier>`. There is no default.

For example, to use the Pause key with no modifier to cycle through virtual machines, add the following line to the `config.ini` file, or modify its value if the option is already listed.

```
FullScreenSwitch.cycleKey = "0x13,0x0"
```

- `FullScreenSwitch.cycleHost`

  Set this option to `TRUE` to include the host operating system in the cycle. The default is `FALSE`.

  For example, to include the host operating system in the cycle, add the following line to the `config.ini` file, or modify its value if the option is already listed:

  ```
  FullScreenSwitch.cycleHost = "TRUE"
  ```

Hot Keys for Switching Directly to Virtual Machines and the Host Computer

You can specify a hot key or hot-key combination for switching directly to any available virtual machine on a host computer. Each time you press the specified hot key, the screen display switches to that of the specified virtual machine. You can also specify a hot key for switching directly to the host operating system.

Virtual Machine Hot Key

You define the hot key used to switch to a virtual machine by adding a line to the target virtual machine's configuration (`.vmx`) file. The value of this option defines the hot key. It is specified as `<key>,<modifier>`. There is no default.

For example, to use Ctrl+Shift+F1 to switch to a particular virtual machine, add the following line to that virtual machine's `.vmx` file or modify its value if the option is already listed:

```
FullScreenSwitch.directKey = "0x70,0x6"
```

If any particular virtual machine is not running, pressing the hot key for that virtual machine has no effect.

Host Operating System Hot Key

You define the hot key used to switch to the host operating system by adding a line to the global configuration file (`config.ini`). The value of this option defines the hot key. It is specified as `<key>,<modifier>`. There is no default.

For example, to use Ctrl+Shift+F9 to switch to the host operating system, add the following line to the `config.ini` file, or modify its value if the option is already listed:

```
FullScreenSwitch.hostDirectKey = "0x78,0x6"
```

Other Entries in the Global Configuration File

The following entries in the global configuration file (`config.ini`) are optional. They enable you to control certain functions of the virtual machine that are important in work environments where virtual machines need to be isolated from each other and from the host computer:

- `Isolation.tools.copy.enable`

  This option determines whether data in one virtual machine or the host operating system can be copied in a way that allows it to be transferred to another virtual machine or to the host operating system. The default setting is `TRUE` (such copying is allowed).

  The setting for this option should be the same as the setting for `Isolation.tools.paste.enable` (below).

- `Isolation.tools.paste.enable`

  This option determines whether data copied in one virtual machine or the host operating system can be pasted into another virtual machine or the host operating system. The default setting is `TRUE` (such pasting is allowed).

  The setting for this option should be the same as the setting for `Isolation.tools.copy.enable` (above).

- `Isolation.tools.HGFS.disable`

  The value of this option determines whether virtual machines can be configured with shared folders, for sharing files among virtual machines and with the host computer. The default setting is `FALSE` (shared folders are enabled).

  The following entries are required in the global configuration file (`config.ini`) and must not be changed:

```
mks.ctlAltDel.ignore = "TRUE"
mks.fullscreen.allowScreenSaver = "TRUE"
fullScreenSwitch.onSeparateDesktop = "TRUE"
msg.autoAnswer = "TRUE"
```

Starting and Stopping Virtual Machines on the User's Computer

Use the `vmware-fullscreen` command to run VMware Workstation in full screen switch mode and to start and stop virtual machines on a user's computer. The command can pass certain information to the virtual machine when it starts.

As administrator, you must decide how to issue the command. For example, you can use a custom application or script running on the host operating system to issue one or more `vmware-fullscreen` commands. Or you can include the command to start a

virtual machine in a shortcut in the host operating system's startup group, so the virtual machine starts when the user logs on to the host computer.

Issue the `vmware-fullscreen` command once for each virtual machine you want to start or stop.

Starting a Virtual Machine

At its most basic, the `vmware-fullscreen` command to power on a virtual machine has the following syntax:

```
vmware-fullscreen -poweron "<config-file>"
```

Provide the full path to the virtual machine's configuration (`.vmx`) file.

The user sees no immediate indication that the virtual machine has started, but the user can switch to the virtual machine with its direct-switch key or with the cycle key.

To power on the virtual machine and pass additional information to the virtual machine, use one or more of the options shown in the following syntax:

```
vmware-fullscreen -poweron [-s variable=value] [-name=<alias>]
                [-directkey=<keyspec>] [-fullscreen] "<config-file>"
```

When you use the optional switches shown here, the `-poweron` switch is required and must be the first switch after the `vmware-fullscreen` command. Provide the full path to the virtual machine's configuration (`.vmx`) file at the end of the command line. Enter the complete command on one line.

Use the `-s` switch to pass a variable name and value to be used in configuring the virtual machine. You can include multiple `<variable>=<value>` pairs in the command. Each `<variable>=<value>` pair must be preceded by `-s`.

Use `-name=<alias>` to give a name to the virtual machine. You can the use that alias in `-switchto` and `-poweroff` commands.

Use `-directkey=<keyspec>` to specify the virtual machine's direct-switch key. If a direct-switch key is specified in the virtual machine's configuration file, the one specified on the command line overrides the one in the configuration file.

For example, to start a virtual machine and specify that its direct-switch key combination is Ctrl+Shift+F1, use the following command:

```
vmware-fullscreen -poweron -directkey=0x70,0x6 "<config-file>"
```

Enter the complete command on one line.

Use `-fullscreen` without `-poweron` to start a virtual machine and go straight to full screen switch mode. The virtual machine takes over the display immediately, instead of running invisibly until the user switches to it later.

Stopping a Virtual Machine

Use either of the following commands to shut down the specified virtual machine:

- `vmware-fullscreen -poweroff "<config-file>"`
- `vmware-fullscreen -poweroff <alias>`

You can specify the path to the configuration (`.vmx`) file, or you can specify the alias if you used `-name=` when you started the virtual machine.

Stopping All Virtual Machines

Use the following command to power off all virtual machines cleanly:

```
vmware-fullscreen -exit
```

Workstation exits as soon as all the virtual machines have powered off.

Switching Among Virtual Machines and the Host

Use one of the following commands to shut down the specified virtual machine:

- `vmware-fullscreen -switchto "<config-file>"`
- `vmware-fullscreen -switchto <alias>`
- `vmware-fullscreen -switchto host`
- `vmware-fullscreen -switchto next`

Depending on which command you use, you can switch to the specified virtual machine, to the host operating system, or to the next machine (virtual machine or host) in the cycling order. A virtual machine must be powered on before you can switch to it. When specifying a virtual machine, you can specify the path to the configuration (`.vmx`) file, or you can specify the alias if you used `-name=` when you started the virtual machine.

Checking the Status of VMware Workstation

Use the following command to find out whether Workstation is running in full screen switch mode:

```
vmware-fullscreen -query
```

If Workstation is in full screen switch mode, the response to this command also reports its process ID and window handle.

Listing All the Virtual Machines Currently Powered On

Use the following command to list all the virtual machines currently powered on:

```
vmware-fullscreen -listvms
```

The list is added to the `vmware-fullscreen` log file.

The vmware-fullscreen Log File

The `vmware-fullscreen` program writes to a log file. This log file records errors reported by `vmware-fullscreen` itself as it starts, stops, and passes other commands to Workstation. It is separate from the `vmware.log` file, which stores information on the running virtual machines.

The name of the `vmware-fullscreen` log file is `vmware-<username>-<pid>.log`. By default, the `vmware-fullscreen` log file is in the `temp` directory for the user logged on to the host computer. This location may be specified in the TEMP environment variable. The default location is:

```
C:\Documents and Settings\<username>\Local Settings\Temp
```

The administrator can specify a different location for this log file by adding the following line to the Workstation global configuration file (`config.ini`):

```
fullScreenSwitch.log.filename="<path>"
```

It is best to use a full path. If you use a relative path, the location is relative to the directory that is active when the `vmware-fullscreen` command is issued for the first time after the host computer reboots.

Guest ACPI S1 Sleep

Workstation provides experimental support for guest operating system ACPI S1 sleep. Not all guest operating systems support this feature. Common guest operating system interfaces for entering standby are supported.

By default, ACPI S1 sleep is implemented within Workstation as suspend. You can use the Workstation **Resume** button to wake the guest.

With the following entry in the configuration (`.vmx`) file for a virtual machine, ACPI S1 sleep is instead implemented as power-on suspend:

```
chipset.onlineStandby = TRUE
```

The guest operating system is not fully powered down. You can awaken the virtual machine:

- Using keyboard input
- Using mouse input
- Through programming the CMOS external timer

This feature can be useful for test and development scenarios.

Workstation Command-Line Reference

A

This appendix discusses the command-line options that are available for the `vmware` program and the `vmrun` program. This appendix contains the following topics:

- "Startup Options for Workstation and Virtual Machines" on page 403
- "Command-Line Application for Operating Virtual Machines" on page 405

For information abut using the `vmware-fullscreen` command to use full screen switch mode, see "Starting and Stopping Virtual Machines on the User's Computer" on page 398.

Startup Options for Workstation and Virtual Machines

Table A-1 describes options available when you run VMware Workstation from the command line. You can type these commands in a Linux terminal window or at the Windows command prompt. You can also create scripts to run multiple commands.

The syntax for this command is:

- On a Linux host operating system:

```
/usr/bin/vmware [-n] [-x] [-X] [-m] [-t] [-q] [-s <variablename>=<value>]
                [-v]
                [/<path_to_virtual_machine>/<virtual_machine_name>.vmx]
                [X toolkit options]
```

- On a Windows host operating system:

```
C:\Program Files\VMware\VMware Workstation\Programs\vmware.exe [-B] [-n]
                [-x] [-X] [-t] [-q] [-s <variablename>=<value>] [-v]
                [<path_to_virtual_machine>\<virtual_machine_name>.vmx]
```

Table A-1. Command-Line Options for the vmware Program

Option	Description
`-n`	Opens a new Workstation window.
`-B`	(Windows hosts only) Opens a new Workstation window but hides the sidebar and toolbars. Only the tabs of open virtual machines are shown. Using this option has the same effect as clicking the **Workstation** icon in the upper-left corner of the Workstation window and choosing **Hide Controls** from the menu that appears.
`-t`	Opens a virtual machine or team in a new tab in the existing Workstation window.
`-x`	Powers on the virtual machine when VMware Workstation starts. This is equivalent to clicking the **Power On** button in the VMware Workstation toolbar.
`-X`	Powers on the virtual machine and switches the VMware Workstation window to full screen mode.
`-m`	(Linux hosts only) Starts the program in quick switch mode.
`-q`	Closes the virtual machine's tab when the virtual machine powers off. If no other virtual machine is open, it also exits Workstation. This is useful when the guest operating system is capable of powering off the virtual machine.
`-s`	Sets the specified variable to the specified value. Any variable names and values that are valid in the configuration file may be specified on the command line with the `-s` switch.
`-v`	Displays the product name, version, and build number.
`<path_to_virtual_machine>` `<path_to_virtual_team>`	Launches a virtual machine using the specified virtual machine or team configuration file (`.vmx` or `.vmtm` file).

On Linux hosts, X toolkit options can be passed as arguments, although some of them (most notably the size and title of the VMware Workstation window) cannot be overridden.

X toolkit options are not relevant on a Windows host.

Using Startup Options in a Windows Shortcut

The most convenient way to use the startup options is to incorporate them into the command generated by a Windows shortcut.

To create the shortcut, right-click the shortcut and click **Properties**. In the **Target** field, add any switches you want to use after the `vmware.exe` filename. For example, the following command launches the Windows Me virtual machine specified, powers it on, and switches to full screen mode.

```
"C:\Program Files\VMware\VMware Workstation\Programs\vmware.exe –X
               C:\Documents and Settings\<username>\My Documents\My Virtual
               Machines\Windows Me\Windows Me.vmx"
```

Enclose the entire command string in quotation marks.

NOTE The configuration file has a `.vmx` extension by default.

Command-Line Application for Operating Virtual Machines

VMware Workstation includes a separate application, `vmrun`, for operating teams or virtual machines from the command line. To launch the `vmrun` application, from the command prompt, enter: **`vmrun COMMAND [OPTION]`**.

Before using the `vmrun` command on a Windows host, you must do one of the following:

- Change your working directory to the VMware Workstation directory. The default location is:

  `c:\Program Files\VMware\VMware Workstation`

- Add the VMware Workstation directory to the system path. On Windows 2000 and XP, you can change this setting at

  Control Panel>System>Advanced>Environment Variables>System variables>Path

Valid `vmrun` commands and options are described in Table A-2.

If authentication is required in the host or guest operating system, use the following authentication flags, as appropriate:

```
-h <hostName>
-P <hostPort>
-u <userName in host OS>
-p <password in host OS>
-gu <userName in guest OS>
-gp <password in guest OS>
```

Table A-2. `vmrun` Commands and Parameters

Command	Description	Parameters
General Commands		
`list`	List all running virtual machines.	None
`upgradevm`	Upgrade a virtual machine to the current Workstation version.	[Path to `.vmx` file]
`installtools`	Install VMware Tools in the guest operating system. In Windows guests, the VMware Tools installer runs automatically. In Linux guests, this command connects the virtual machine's virtual CD-ROM drive to the VMware Tools ISO image for that guest, but the installer does not start automatically. Complete the installation with additional manual steps, as described in "Installing VMware Tools on a Linux Guest" on page 123.	[Path to `.vmx` file]
Power Commands		
`start`	Start a virtual machine (`.vmx` file) or team (`.vmtm` file).	[Path to `.vmx` or `.vmtm` file]
`stop`	Stop a virtual machine (`.vmx` file) or team (`.vmtm` file).	[Path to `.vmx` or `.vmtm` file] [hard|soft]
`reset`	Reset a virtual machine (`.vmx` file) or team (`.vmtm` file).	[Path to `.vmx` or `.vmtm` file] [hard|soft]
`suspend`	Suspend a virtual machine (`.vmx` file) or team (`.vmtm` file).	[Path to `.vmx` or `.vmtm` file] [hard|soft]
Snapshot Commands		
`snapshot`	Create a snapshot of a virtual machine.	[Path to `.vmx` file] [snapshot name]
`listSnapshots`	List all snapshots in a virtual machine.	[Path to `.vmx` file]

Table A-2. `vmrun` Commands and Parameters (Continued)

Command	Description	Parameters
`deleteSnapshot`	Remove a snapshot from a virtual machine.	[Path to `.vmx` file] [snapshot name]
`revertToSnapshot`	Go to a snapshot in a virtual machine. If a snapshot has a unique name within a virtual machine, revert to that snapshot by specifying the path to the virtual machine's configuration file and the snapshot name: [Path to `.vmx` file][snapshot name] If several snapshots have the same name, you can still specify a snapshot by including a "path name" for the snapshot name. A path name is a series of snapshot names, separated by forward slash characters (/). Each name specifies a different snapshot in the tree. For example, suppose you include the path name `Snap1/Snap2`. This will identify a snapshot named Snap2 that was taken from the state of a root snapshot named Snap1. Because you can use the forward slash in a path name, VMware recommends that you avoid using the slash character when you name a snapshot because this makes it difficult for you to predict which snapshot a path name will identify.	[Path to `.vmx` file] [snapshot name] or [Path to `.vmx` file] [snapshot name1/ snapshot name2]
Guest Operating System Commands		
`runProgramInGuest`	Run a program in the guest operating system.	[Path to `.vmx` file] [Program [Program arguments]]
`fileExistsInGuest`	Check whether the specified file exists in the guest system.	[Path to `.vmx` file] [Path to file in guest]
`setSharedFolderState`	Modify the location of a folder shared between the host and guest.	[Path to `.vmx` file] [Share name] [New path to folder on host]
`addSharedFolder`	Add a folder to be shared between the host and guest.	[Path to `.vmx` file] [Share name] [Path to folder on host]

Table A-2. `vmrun` Commands and Parameters (Continued)

Command	Description	Parameters
`removeSharedFolder`	Remove a folder shared between the host and guest.	[Path to `.vmx` file] [Share name]
`listProcessesInGuest`	List the processes running in the guest operating system.	[Path to `.vmx` file]
`killProcessInGuest`	Kill the specified process on the guest operating system.	[Path to `.vmx` file] [Process ID]
`runScriptInGuest`	Run a script in the guest operating system.	[Path to `.vmx` file] [Interpreter path script text]
`deleteFileInGuest`	Delete a file from the guest operating system.	[Path to `.vmx` file] [Path to file on the guest]
`createDirectoryInGuest`	Create a directory in the guest operating system.	[Path to `.vmx` file] [Directory path on the guest]
`deleteDirectoryInGuest`	Delete a directory from the guest operating system.	[Path to `.vmx` file] [Directory path on the guest]
`listDirectoryInGuest`	List the contents of a directory in the guest operating system.	[Path to `.vmx` file] [Directory path on the guest]
`copyFileFromHostToGuest`	Copy a file from the host to the guest operating system.	[Path to `.vmx` file] [File path on the host] [File path on the guest]
`copyFileFromGuestToHost`	Copy a file from the guest operating system to the host.	[Path to `.vmx` file] [File path on the guest] [File path on the host]
`renameFileInGuest`	Rename a file in the guest operating system.	[Path to `.vmx` file] [Original file name] [New file name]

Examples for vmrun

For example, to reset a virtual machine:

- In a Linux terminal, enter:

  ```
  vmrun reset /usr/local/VMs/<virtual_machine_name>.vmx soft
  ```

- On the Windows command line, enter:

  ```
  vmrun reset c:\Virtual Machines\<virtual_machine_name>.vmx soft
  ```

With virtual machines that require input through a VMware Workstation dialog box, `vmrun` might time out and fail. To disable Workstation dialog boxes, insert the following line into the configuration (`.vmx`) file for a virtual machine:

```
msg.autoAnswer = TRUE
```

Using the Eclipse Integrated Virtual Debugger

B

The Eclipse Integrated Virtual Debugger provides a configurable interface between Eclipse and virtual machines, making it easy to develop and debug applications that run in multiple operating system environments on a single PC. Debugging your applications in virtual machines enables you to reproduce and record errors while maintaining the integrity of the host machine. You can perform typical debugging tasks such as pausing at breakpoints, stepping through code, and viewing and modifying the state of your application, all without impacting the host environment.

This appendix contains the following sections:

- "Overview of the Eclipse Integrated Virtual Debugger" on page 411
- "Setting Up the Eclipse Integrated Virtual Debugger Environment" on page 413
- "Managing Virtual Machine Launch Configurations" on page 417
- "Running and Debugging Applications in Virtual Machines" on page 421

Overview of the Eclipse Integrated Virtual Debugger

The Eclipse Integrated Virtual Debugger enables you to:

- Manage launch configuration settings for application execution and debugging in virtual machines.
- Start an application debugging session in a virtual machine.
- Start an application in a virtual machine without debugging.
- Start a debugging session that attaches to a process already running in a virtual machine.

Using Eclipse launch configurations, you can choose what virtual machine to run your application in and how it is executed. Once configured, the Eclipse Integrated Virtual Debugger finds the virtual machine, powers it on if necessary, sets up the environment based on your configuration settings, and starts or attaches to the application.

To configure how an application is started in a virtual machine, you can specify:

- The name of the virtual machine (`.vmx` configuration file).
- (Optional) The path to the JVM on the guest system.
- (Optional) The location of folders to be shared between the host and the guest.
- (Optional) Actions to perform before launching an application from Eclipse, including:
  - Revert to the most recent snapshot.
  - Run specified pre-execution commands.
- (Optional) Actions to perform after an application launched from Eclipse is terminated, including:
  - Run specified post-execution commands (for example, to perform cleanup tasks).
  - Set the virtual machine state to:
    - Suspended (default)
    - Revert to the most recent snapshot
    - Powered off

For information on installation requirements for the Eclipse Integrated Virtual Debugger, see "Setting Up the Eclipse Integrated Virtual Debugger Environment" on page 413.

For information on how to manage virtual machine configurations, see "Managing Virtual Machine Launch Configurations" on page 417.

For more information on running and debugging applications in virtual machines, see "Running and Debugging Applications in Virtual Machines" on page 421.

Setting Up the Eclipse Integrated Virtual Debugger Environment

Review the requirements and recommendations in this section before following the instructions in Chapter 2, "Installing VMware Workstation," on page 43 to install the Eclipse Integrated Virtual Debugger as an optional component of Workstation 6. This section describes the requirements for host and guest systems, Eclipse, and the Java Runtime Environment (JRE).

During Windows installation, if Eclipse is not installed in `C:\Program Files\Eclipse` or `C:\Eclipse`, you must use the **Custom** setup to select the Eclipse Integrated Virtual Debugger component and specify the Eclipse directory location.

During Linux installation, you must override the default value of **No** when prompted by `vmware-config.pl` to install the Eclipse Integrated Virtual Debugger.

When you install the Eclipse Integrated Virtual Debugger:

- The Eclipse Integrated Virtual Debugger plug-in, `ivd.jar`, Foundry Java bindings, and the `plugin.xml` launch configuration file are placed in the `com.vmware.bfg_1.0.0` subdirectory of the Eclipse plug-in directory.
- After you restart Eclipse, the **Debug** menu includes the new launch configuration types **VMware attach to application** and **VMware execute Java application**. These launch configuration types have a VMware tab that enables you to configure virtual machine settings.

You can debug in multiple virtual machines simultaneously. You can also debug multiple sessions in a single virtual machine.

Host System Requirements

The Eclipse Integrated Virtual Debugger can run on any supported host operating system that is running Workstation 6 and has Eclipse installed. Eclipse must be running on the same system as Workstation 6. See "Eclipse Requirements" for additional Eclipse requirements.

Supported Host Operating Systems

The Eclipse Integrated Virtual Debugger supports the following Windows 32-bit host operating systems:

- Windows Vista Enterprise Edition
  Windows Vista Business Edition
  Windows Vista Home Basic and Premium Editions
  Windows Vista Ultimate Edition
- Windows XP Home Edition, SP1, SP2
  Windows XP Professional, SP1, SP2
- Windows 2000 Server SP3, SP4
  Windows 2000 Professional, SP3, SP4
  Windows 2000 Advanced Server, SP3, SP4

NOTE Windows 64-bit host operating systems are not currently supported.

The Eclipse Integrated Virtual Debugger supports the following Linux 32-bit and 64-bit host operating systems:

- Red Hat Enterprise Linux WS 4.5 (Beta, formerly called 4.0 Update 5)
  Red Hat Enterprise Linux AS 4.0, updates 1, 2, 3, 4
  Red Hat Enterprise Linux ES 4.0, updates 1, 2, 3, 4
  Red Hat Enterprise Linux WS 4.0, updates 1, 2, 3, 4

  Red Hat Linux 9.0 — stock 2.4.20-8, upgrade 2.4.20-20.9
- Ubuntu Linux 6.10
  Ubuntu Linux 6.06

Supported JRE Versions

The host system must be running a Java Runtime Environment (JRE) meeting Java 2 Platform Standard Edition (J2SE) 5.0 or higher specifications. J2SE consists of the JRE and developer tools for compiling, debugging, and running applications written in the Java language.

NOTE Eclipse displays the error message `unable to load class` if an unsupported version of J2SE is being used on the host system.

Eclipse Requirements

You must have Eclipse 3.2 installed on the host. On Windows Vista hosts, you must have Eclipse 3.2.2 installed.

The Java language is supported. You cannot have GCJ Java installed on the guest operating system.

Review "Virtual Machine Requirements" for information about guest system requirements.

Virtual Machine Requirements

The Eclipse Integrated Virtual Debugger is supported on any Workstation 6 virtual machine that is running a supported Windows or Linux guest operating system.

Supported Guest Operating Systems

This section provides a simplified list of guest operating systems supported for debugging in virtual machines. For the most recent list of supported guest operating systems, including detailed information about the specific operating system versions, service packs, and updates supported, see the *VMware Guest Operating System Installation Guide*, at http://pubs.vmware.com/guestnotes/. This guide also provides notes on installing the most common guest operating systems.

Operating systems that are not listed are not supported for debugging in a virtual machine.

The following Windows 32-bit guest operating systems are supported:

- Windows Vista (all except Vista Home Edition, which cannot be run in a virtual machine due to Microsoft licensing restrictions)
- Windows Server 2003, Enterprise Edition and R2
- Windows XP Professional and Home Edition
- Windows 2000 Professional
  Windows 2000 Server
  Windows 2000 Advanced Server

The following Windows 64-bit guest operating systems are supported:

- Windows Vista x64 Edition (3-D effects not yet supported)
- Windows Server 2003 x64 Edition
- Windows XP Professional x64

The following Linux 32-bit and 64-bit guest operating systems are supported:

- Red Hat Linux 8 and 9
- Red Hat Enterprise Linux Advanced Server, Enterprise Server, and Workstation 4 and 5
- Ubuntu Linux 6.10
  Ubuntu Linux 6.06
- SUSE Linux 10
- SUSE Linux Enterprise Server 10

VMware Tools Requirements

Make sure that the version of VMware Tools on the guest operating system matches the version of Workstation 6 (which the Eclipse Integrated Virtual Debugger is a component of) on the host.

Java and JRE Requirements

You cannot have GCJ Java installed on the guest operating system.

The guest operating system must be running JRE 1.4.2 or higher. If you are not using JRE 5.0 on the guest, you must update the build settings in Eclipse to be compatible with the older JRE.

To update the Eclipse build settings to use a 1.4.x JRE on the guest

1 In the Eclipse Package Explorer, right-click the topmost folder (Project item) and choose **Properties**.

2 In the left pane of the Properties page, select **Java Compiler**.

3 Select **Enable project specific settings**, and set the JDK Compliance Compiler compliance level to `1.4`.

Installing PSAPI.DLL on Windows NT

On Windows NT, you must install the `psapi.dll` library file to retrieve process status information so that the Eclipse Integrated Virtual Debugger can attach to a process. You can download `psapi.dll` from
http://www.microsoft.com/downloads/release.asp?releaseid=30337.

Disabling the Firewall on Linux Guest Systems

You must disable the firewall on Linux guest operating systems. The Eclipse Integrated Virtual Debugger opens an available port (searching from port 49152) for each debugging session.

Configuring the Firewall on Windows Guest Systems

If you are using a 1.4.x JRE on Windows guest systems, you must either disable the firewall or allow incoming connections to the JVM. If you have a Windows system (such as Windows XP SP2, Windows 2003, and Windows Vista) that allows you to configure exceptions to the firewall, you can add the JVM to the exceptions list.

To add the JVM to the exceptions list

1 Choose **Start>Control Panel>Windows Firewall** and select the **Exceptions** tab.

2 Click **Add Program** and browse to the Java executable.

3 Click **OK**.

NOTE On Windows Vista guests, you might have to restart the firewall after configuring it to allow incoming connections to the JVM.

Managing Virtual Machine Launch Configurations

You can manage configuration settings for each virtual machine in which you want to debug applications. Eclipse Integrated Virtual Debugger launch configurations determine which virtual machine to run the application in and how the application is executed.

The launch configuration types **VMware attach to application** and **VMware execute Java application** have a **VMware** tab. The values you enter in the **VMware** tab determine virtual machine configuration settings. Once configured, you can start and attach to applications in virtual machines from the Eclipse **Debug** and **Run** menus.

Choose **Run>Debug** to manage launch configurations. You can create, duplicate, edit, and remove configurations.

Using Application Configurations to Start Applications in a Virtual Machine

This section describes the virtual machine settings you can configure to start an application in a virtual machine.

To create, duplicate, or edit a launch configuration to start an application in a virtual machine

1 Choose **Run>Debug.**

The **Debug** page is displayed. You can create, manage, and run configurations from this page.

2 You can create a launch configuration based on default settings or based on another configuration. You can also edit an existing configuration. Do one of the following:

- Create a configuration based on default settings by selecting **VMware execute Java application** in the left pane, and clicking the **New launch configuration** icon at the top of the pane.
- Create a configuration based on another configuration by selecting the configuration you want to duplicate under **VMware execute Java application** in the left pane, and clicking the **Duplicates the currently selected configuration** icon at the top of the pane.
- Edit an existing configuration by selecting the configuration you want to edit under **VMware execute Java application** in the left pane.

Perform the remaining steps in the **VMware** tab of the right pane.

3 Choose a virtual machine from the drop-down menu of recently used and currently running virtual machines.

Click **Browse** to select from `.vmx` files on the system.

4 (Optional) If you want to use a JVM other than the one that is automatically selected, select an alternate JVM path.

5 (Optional) Expand the list of shared folders to add, edit, or remove folders to be shared between the host and the guest systems.

For each folder, enter the share name and the location on the host system.

By default, the project folder is shared.

6 (Optional) Indicate actions to be performed before the application is launched:

- Select **Set virtual machine state to most recent snapshot** to revert to the most recent snapshot before the application is launched.
- Select **Run script** and enter one or more shell commands to be executed in the guest operating system before the application is launched. No syntax checking is performed. Either enter one command per line, or enter multiple commands on the same line using a semicolon as a separator.

7 (Optional) Indicate actions to be performed after the application has terminated:

- Select **Run script** and enter one or more shell commands to be executed in the guest operating system after the application has terminated. No syntax checking is performed. Either enter one command per line, or enter multiple commands on the same line using a semicolon as a separator.
- Select **Set virtual machine state**, and select one of the following options:
  - **to suspended** (default)
  - **to most recent snapshot**
  - **to powered-off**

8 Click **Apply**.

If you click **Revert**, settings revert to previous values.

If newly created, the launch configuration is added to the left pane.

Using Application Configurations to Attach to Applications Running in a Virtual Machine

This section describes the virtual machine settings you can configure to attach to an application that is already running in a virtual machine.

To create, duplicate, or edit a configuration that attaches to a running application in a virtual machine

1 Choose **Run>Debug**.

The **Debug** page is displayed. You can create, manage, and run configurations from this page.

2 You can create a launch configuration based on default settings or based on another configuration. Do one of the following:

- Create a configuration based on default settings by selecting **VMware attach to application** in the left pane, and clicking the **New launch configuration** icon at the top of the pane.
- Create a configuration based on another configuration by selecting the configuration you want to duplicate under **VMware attach to application** in the left pane and clicking the **Duplicates the currently selected configuration** icon at the top of the pane.
- Edit an existing configuration by selecting the configuration you want to edit under **VMware attach to application** in the left pane.

Perform the remaining steps in the **VMware** tab of the right pane.

3 Choose a virtual machine from the drop-down menu of recently used and currently running virtual machines.

Click **Browse** to select from `.vmx` files on the system.

4 Click **Apply**.

If you click **Revert**, settings revert to default values.

If newly created, the launch configuration is added to the left pane.

Deleting Configurations

You can remove an existing configuration.

To remove a configuration

1 Choose **Run>Debug**.

The **Debug** page is displayed. You can create, manage, and run configurations from this page.

2 In the left pane, select one or more configurations you want to delete and click the **Delete selected launch configuration(s)** icon at the top of the pane.

The configuration is removed in the left pane.

Running and Debugging Applications in Virtual Machines

Once you have created the appropriate launch configurations, the Eclipse Integrated Virtual Debugger enables you to:

- Start an application debugging session in a virtual machine.
- Start an application in a virtual machine without debugging.
- Start a debugging session that attaches to a process already running in a virtual machine.

Starting an Application Debugging Session in a Virtual Machine

You can debug an application in any configured virtual machine.

To start a debugging session in a virtual machine

1 Begin the session in one of the following ways:

- From the **Debug** menu, choose the configuration for the application you want to start debugging.
- In the **Debug** page, select the configuration under **VMware execute Java application** in the left pane and click **Debug** in the right pane.

2 Perform debugging tasks as you would in a local debugging environment.

NOTE Do not suspend a virtual machine while the Eclipse Integrated Virtual Debugger is connected to an application. If you do, the Eclipse Integrated Virtual Debugger will disconnect from the application.

Starting an Application in a Virtual Machine Without Debugging

You can start an application without debugging in any configured virtual machine.

Begin the session in one of the following ways:

- From the **Run** menu, choose the configuration for the application you want to start.
- In the **Run** page, select the configuration under **VMware execute Java application** in the left pane and click **Run** in the right pane.

Attaching the Debugger to an Application Running in a Virtual Machine

You can attach the debugger to any Java application that is running in a virtual machine.

To attach to an application that is running in a virtual machine

1. In the **Debug** page, select the configuration under **VMware attach to application** in the left pane and click **Debug** in the right pane.
2. If more than one instance of the Java application is running in the virtual machine, a dialog box appears with a list of the running instances, each identified by their process ID, port number, and arguments.

   Select the process you want to attach to.
3. Perform debugging tasks as you would in a local debugging environment.

NOTE Do not suspend a virtual machine while the Eclipse Integrated Virtual Debugger is connected to an application. If you do, the Eclipse Integrated Virtual Debugger will disconnect from the application.

Using the Visual Studio Integrated Virtual Debugger

C

The Visual Studio Integrated Virtual Debugger provides a configurable interface between Visual Studio and virtual machines, making it easy to develop and debug applications that run in multiple Windows operating system environments on a single PC. Debugging your applications in virtual machines enables you to reproduce and record errors while maintaining the integrity of the host machine. You can perform typical debugging tasks such as pausing at breakpoints, stepping through code, and viewing and modifying the state of your application, all without impacting the host environment.

This chapter contains the following sections:

- "Overview of the Visual Studio Integrated Virtual Debugger" on page 423
- "Setting Up the Visual Studio Integrated Virtual Debugger Environment" on page 426
- "Managing Virtual Machine Configurations" on page 433
- "Running and Debugging Applications in Virtual Machines" on page 438

Overview of the Visual Studio Integrated Virtual Debugger

The Visual Studio Integrated Virtual Debugger enables you to:

- Manage configuration settings for application execution and debugging in virtual machines.
- Start an application debugging session in a virtual machine.

- Start an application in a virtual machine without debugging.
- Start a debugging session that attaches to a process already running in a virtual machine.

You can manage configuration settings for each virtual machine in which you want to execute and debug applications. Virtual machine configuration properties, which you set in the Visual Studio Integrated Virtual Debugger configuration pages, determine which virtual machine to run the application in and how the application is executed.

Once configured, the integrated virtual debugger finds the virtual machine, powers it on if necessary, sets up the environment based on your configuration settings, and starts or attaches to the application.

For information on installation and other requirements for the Visual Studio Integrated Virtual Debugger, see "Setting Up the Visual Studio Integrated Virtual Debugger Environment" on page 426.

For information on how to manage virtual machine configurations, see "Managing Virtual Machine Configurations" on page 433.

For information on running and debugging applications in virtual machines, see "Running and Debugging Applications in Virtual Machines" on page 438.

Configuration Options When Starting an Application in a Virtual Machine

To configure how to start an application (with or without debugging) in a virtual machine, you can specify the following settings in the Visual Studio Integrated Virtual Debugger configuration pages:

- The command to be executed by Visual Studio in the guest operating system.
- The name of the virtual machine (`.vmx` configuration file).
- Whether to run the command as a shared path on the host or as a guest path.
- The location of the Remote Debug Monitor on the host.
- The name of the Remote Debug Monitor on the guest.

You can specify the following additional settings when you start debugging an application in a virtual machine, but not when you start an application without debugging:

- (Optional) The location of folders to be shared between the host and the guest.
- (Optional) Actions to perform before starting an application in a virtual machine, including:

- Copying files or folders from the host to the virtual machine.
- Reverting the virtual machine to the parent snapshot.
- Running specified pre-execution commands on the guest. For example, if you must register new DLLs in the virtual machine each time the program is recompiled, you can create a DLL registration script and specify that it must be run during setup.

- (Optional) Actions to perform after an application in a virtual machine is terminated, including:
  - Running specified post-execution commands (for example, to perform cleanup tasks) in the guest.
  - Setting the virtual machine state to:
    - No operation (remain powered on, no shutdown action)
    - Powered off
    - The parent snapshot
    - Suspended

Configuration Options When Attaching to a Process Running in a Virtual Machine

To configure a debugging session that attaches to a process already running in a virtual machine, you can specify the following in the Attach to Process dialog box:

- The name of the virtual machine (`.vmx` configuration file).
- The location of the Remote Debug Monitor on the host.
- The name of the Remote Debug Monitor on the guest.

Setting Up the Visual Studio Integrated Virtual Debugger Environment

Review the requirements and recommendations in this section before following the instructions in Chapter 2, "Installing VMware Workstation," on page 43 to install the Visual Studio Integrated Virtual Debugger as an optional component of Workstation 6. The Visual Studio Integrated Virtual Debugger can be installed on most Windows host systems that are running Workstation 6 and have a supported version of Visual Studio installed.

When you install the Visual Studio Integrated Virtual Debugger:

- The associated DLLs are placed in the `\Program Files\VMware\VMware Workstation\Visual Studio Integrated Debugger` and `\Program Files\VMware\VMware VIX\ws-2\32bit` directories.
- When you restart Visual Studio, the integrated virtual debugger is loaded and the **VMware** menu and toolbar become available.
- A preference file, `vsid-prefs.xml`, is created in the `\Documents and Settings\<user_name>\Application Data\VMware` directory. Do not edit this file directly. It is updated when you make changes in the integrated virtual debugger configuration pages.
- A file, <project_name>`.idc`, is created for each project in same directory as the project file when a project of a type supported by the integrated virtual debugger is loaded in Visual Studio.
- A log file, `vmware-vsid-<integer>.log`, is created in the `\Documents and Settings\<user_name>\Local Settings\Temp` directory. You can choose **VMware>About VMware Virtual Debugger** to view the log file name. This log file contains informational and error messages about the actions of the integrated virtual debugger.

You can debug in multiple virtual machines simultaneously. You can also debug multiple sessions in a single virtual machine. However, you cannot debug on a local or physically remote machine and in a virtual machine at the same time.

Microsoft Visual Studio Requirements and Recommendations

This section includes requirements and configuration recommendations for Visual Studio.

Visual Studio must be running on the same system as Workstation 6.

Supported Versions of Visual Studio

Only Visual Studio 2005 Professional and Team Systems editions are supported. These versions of Visual Studio allow remote debugging on Windows systems, with the exceptions of Windows NT and Windows Vista Starter Edition. The Visual Studio Integrated Virtual Debugger uses the features of the Remote Debug Monitor (`msvsmon.exe`) to communicate with the guest operating system.

VMware recommends that you install Visual Studio 2005 SP1. For more information, see http://msdn2.microsoft.com/en-us/vstudio/bb265237.aspx.

For important information about running Visual Studio 2005 on Windows Vista, see http://msdn2.microsoft.com/en-us/vstudio/aa972193.aspx.

Running the Visual Studio Integrated Virtual Debugger on Windows Vista Starter Edition is not supported. For information about issues running Visual Studio on Windows Vista Starter Edition, see http://msdn2.microsoft.com/en-us/vstudio/aa964140.aspx#question46.

Supported Languages

The C/C++ (Native and Managed), C#, and Visual Basic languages are supported.

Configuring the Runtime Library Setting for C++ Applications

When you debug on a physically remote machine or in a virtual machine, the application might not start if the runtime library setting is set to certain values. If you encounter this problem, change the C++ runtime library setting.

To update the Visual Studio runtime library setting

1 Choose **Project>Properties**.

2 Expand **Configuration Properties>C/C++** and select **Code Generation**.

3 Set **Code Generation** to **Runtime Library property to Multi-threaded (/MT)** or **Multi-threaded Debug (/MTd)**.

For additional information, see http://msdn2.microsoft.com/en-us/library/ms235624.aspx.

Host System Requirements

The Visual Studio Integrated Virtual Debugger can run on most Windows host operating systems supported by Workstation 6, listed in "Windows Host Operating Systems (32-Bit)" on page 31 and "Windows Host Operating Systems (64-Bit)" on page 32. On Windows Server 2003, only Enterprise Edition SP1 and R2 are supported.

If remote debugging is not working on a Windows Vista host, try the following:

- Manually configure the firewall to allow traffic from Visual Studio.
- Run Visual Studio with Administrator permissions. For more information, see http://msdn2.microsoft.com/en-us/vstudio/aa972193.aspx.

Virtual Machine Requirements and Recommendations

This section includes requirements and configuration recommendations for virtual machines.

Guest Operating System Support

The Visual Studio Integrated Virtual Debugger is supported on any Workstation 6 virtual machine that is running a supported Windows guest operating system, with the exceptions of Windows NT, Windows Me, Windows 98, Windows 95, Windows for Workgroups, Windows 3.1, Windows XP Home Edition, and Windows Vista Starter Edition.

Make sure that the version of VMware Tools on the guest operating system matches the version of Workstation 6 (which the Visual Studio Integrated Virtual Debugger is a component of) on the host.

Configuring the Network

Set up the virtual machine network as **Bridged** or **Host-only**.

On Windows XP, in the guest system **Control Panel>Administrative Tools>Local Security Policy>Local Policies>Security Options** page, set the policy **Network access: Sharing and security model for local accounts** to **Classic - local users authenticated as themselves**.

On Windows Vista, **Classic - local users authenticated as themselves** is the default value for this policy. To verify that this policy is set correctly, follow the same steps as for Windows XP.

NOTE It is not possible to view this policy on Windows Vista Home Premium and Vista Home Basic.

Configuring the Firewall on Windows XP SP2 Virtual Machines

Windows XP SP2 systems have the firewall enabled by default. To debug in a virtual machine with Windows XP SP2, you must disable the firewall or configure it appropriately. VMware recommends disabling the firewall. Virtual machines are protected behind the host firewall.

For information on setting up remote debugging in Visual Studio using Windows XP SP2 with the firewall enabled, see:

- http://msdn.microsoft.com/security/productinfo/xpsp2/default.aspx?pull=/library/en-us/dnwxp/html/xpsp2remotedebug.asp
- http://support.microsoft.com/default.aspx?scid=kb;%5BLN%5D;833977#2020

Configuring User Accounts

Log in to the guest operating system with an Administrator account. Use the same local or domain user account on the host machine to log in to the guest operating system.

NOTE The user name, password, and domain name (if not local on both systems) must match on the host and the guest. Otherwise the Remote Debug Monitor on the guest will not be able to communicate with the Visual Studio debugger on the host.

For additional information on setting up Windows user accounts for remote debugging, see http://msdn2.microsoft.com/en-us/library/ms164725.aspx.

NOTE Communication between Visual Studio and the guest operating system is not initiated until the virtual machine is powered on and the configured user is logged in. This user runs the Remote Debug Monitor on the guest, which in turn communicates with the Visual Studio debugger on the host.

To prevent a time delay, power on the virtual machine and log in to the guest operating system before debugging in a virtual machine. You can set up automatic login to bypass the login screen when the guest is booting, as described next.

Setting the Password Policy

Windows has a default security feature that helps protect users with blank passwords from network-based attacks. Users who do not password-protect their accounts can log in only at their physical computer console: the monitor, keyboard, and mouse that is physically connected to their computer. This restriction applies only to local user accounts, not to domain user accounts.

For information on how to disable blank password restrictions, see http://support.microsoft.com/?id=303846.

Suppressing Security Prompts

Running an application from a network share triggers a security prompt every time the file is accessed. VMware recommends that you turn off security prompts on the guest operating system.

To turn off security prompts on the guest system

1 In Internet Explorer, choose **Tools>Internet Options>Security>Local Intranet**, and click **Sites**.

2 Click **Advanced**, and add a new Web site: `file://*..host`

Alternatively, you can edit the registry key directly.

To turn off security prompts by editing the registry key

1 Open the registry.

2 Add a new key, `.host`, under `HKCU\Software\Microsoft\Windows\CurrentVersion\InternetSettings\ZoneMap\Domains`.

3 In the `.host` key, create a new **DWORD Value** called `file` and set its value to `1`.

Installing the Microsoft .NET Framework to Support Managed Applications

To debug managed C++, C#, and Visual Basic applications, which use the Common Language Runtime, you must install the Microsoft .NET Framework version 2.0 or higher on the guest operating system.

Using Unique Virtual Machine Computer Names

Verify that the computer names are unique on all virtual machines, otherwise the Visual Studio Integrated Virtual Debugger cannot find the appropriate virtual machine on the network.

To rename a computer

1 On the guest system, choose **Start>Control Panel>System**.

2 Select the **Computer Name** tab.

3 Click **Change**.

4 Type a unique name, and click **OK**.

Installing and Starting the Remote Debug Monitor Manually on Windows 98 Guest Systems

To enable debugging in a virtual machine, the Visual Studio Integrated Virtual Debugger shares the host folder that contains the Remote Debug Monitor, and runs that Remote Debug Monitor on the guest. On Windows 98, it is not possible to run the Remote Debug Monitor (or any executable) from a shared folder. An attempt to do so generates the error: `The remote debugger is not properly installed. On a Windows ME or Windows 98 computer, the debugger cannot be run off a file share. Run the remote debugger setup`.

Instead, you must manually install and start the Remote Debug Monitor executable, `msvsmon.exe`, on the guest operating system before starting a debugging session. You can copy `msvsmon.exe` to the guest before starting the debug session, create a mapping to a network share with the host where `msvsmon.exe` is located, or install `msvsmon.exe` from the Visual Studio 2005 installation CD.

NOTE Once the debugging session starts, click **Yes** when prompted to use the existing instance of the Remote Debug Monitor.

Due to this shared folder limitation, you must also:

- Set **Run Command As** to **a guest path**. This property, which indicates how the command being executed by the debugger is run, is described in "Setting General Properties" on page 435.
- Leave **Shared Directories** unset, because directories cannot be shared between the host and the guest. This property is described in "Setting Virtual Machine Properties" on page 436.

Troubleshooting Tips

This section contains additional information that enables you to use the Visual Studio Integrated Virtual Debugger successfully.

Changing Shortcut Keys

If you change the shortcut keys for `VMDebugger` commands (in **Tools>Options>Keyboard**), the tooltips for the VMware menu and toolbar will not reflect the changes until you restart Visual Studio.

Reinstalling VMware Tools If the Debugging Session Does Not Start

If the debugging session fails to start and the last message in the VMware output window (and log file) is `Waiting for VMware Tools to start`, check whether the guest system has the latest VMware Tools installed and running. If not, upgrade to the latest version of VMware Tools. See "Upgrading VMware Tools" on page 114.

Exiting Visual Studio Before Powering Off a Virtual Machine

If you attempt to exit Visual Studio after starting a debugging session but before logging in or running VMware Tools on the guest, Visual Studio will not exit until the virtual machine is powered off or the user is logged in to the guest operating system.

Unloading the VMDebugger Add-in

To permanently uninstall the Visual Studio Integrated Virtual Debugger, run the Workstation installation program, select **Modify** on the Program Maintenance page, deselect **Visual Studio PlugIn** in the **Custom** setup, and continue through the installation wizard.

NOTE Deselecting **Start** in **Tools>Add-In Manager** does not prevent the Visual Studio Integrated Virtual Debugger Add-in from loading.

Cleaning Up After a Crash

If you try to run the debugger locally after a debugging session in a virtual machine crashes or freezes, you might get a Visual Studio error that indicates that the remote server cannot be found.

To reset Visual Studio to debug locally:

- In C++, choose **Project Property Pages>Debugging** and set the **Debugger to Launch** property to `Local Windows Debugger`. Set the **Command** property to either an empty string or the correct local path.
- In C# and VB, choose **Project Property Pages>Debug**. Make sure **Start project** is selected and **Use remote machine** is deselected.

Optionally, remove any shared folders that were used to run the debug command and the Remote Debug Monitor. Shared folders are usually removed at the end of a debugging session, but they might not be removed in the following circumstances:

- If the debugging session causes a crash.
- If the virtual machine is powered off while the debugging session is still running.

These shared folders are typically reused when another debugging session is started, so this cleanup is not required.

Managing Virtual Machine Configurations

Before you can start or debug applications in a virtual machine, you must create or modify virtual machine configurations and set configuration properties. The Default configuration initially includes the default values for all properties that have them.

Choose **VMware>Options** to manage configurations. You can create, rename, and remove configurations as described in this section, and you can set and modify configuration properties for existing configurations as described in "Setting Configuration Properties" on page 435.

The configuration selected in the **Configuration** drop-down menu is the one being edited in the configuration pages, while the configuration selected in the **Active Configuration** drop-down menu is the one used when you choose **VMware>Start** or **VMware>Start Without Debugging**.

Creating Configurations

This section describes how to create a new configuration.

To create a new configuration

1 Choose **VMware>Options**.

2 Click the **New** icon next to the **Configuration** drop-down menu.

3 In the New Configuration page, type a name for the new configuration.

4 Choose a configuration to copy settings from.

5 The default selection is **<Default>**, which includes the default values for all properties that have them.

6 Click **OK**.

The new configuration is created and listed as the active configuration in the **Configuration** and **Active Configuration** drop-down menus. Next, edit the configuration properties, as described in "Setting Configuration Properties" on page 435.

Renaming Configurations

You can rename an existing configuration.

To rename a configuration

1 Choose **VMware>Options**.

2 Choose the configuration you want to rename from the **Configuration** drop-down menu, and click the **Edit** icon.

3 In the Edit Configuration page, select the configuration you want to rename, and click **Rename**.

4 Type the new name over the existing name, and press **Enter**.

5 At the confirmation prompt, click **Yes**.

6 Click **Close**.

The renamed configuration is listed as the active configuration in the **Configuration** drop-down menu. You can edit its configuration properties, as described in "Setting Configuration Properties" on page 435.

Removing Configurations

You can remove an existing configuration.

To remove a configuration

1 Choose **VMware>Options**.

2 Choose the name of the configuration you want to delete from the **Configuration** drop-down menu, and click the **Edit** icon.

3 In the Edit Configuration page, select the configuration you want to delete, and click **Remove**.

4 At the confirmation prompt, click **Yes**.

5 Click **Close**.

The configuration is removed from the **Configuration** drop-down menu.

Setting Configuration Properties

You can edit configuration properties for a specific configuration by choosing the configuration name from the **Configuration** drop-down menu. You can also edit configuration properties for all configurations by choosing **All Configurations** from the **Configuration** drop-down menu.

The Default configuration initially includes the default values for all properties that have them.

Setting General Properties

General properties include:

- The command to be executed by Visual Studio in the guest operating system.
- How the command is run: as a path on the host in a shared folder or as a path on the guest.
- The location of the Remote Debug Monitor on the host.
- The name of the Remote Debug Monitor on the guest.

To set general properties

1 Choose **VMware>Options**, and select **General** in the left pane.

2 Set **Command** to the command to be executed by the debugger in the guest system.

Click **Browse** to select a path to the executable on the host file system.

The command directory is automatically shared between the host and the guest.

3 Set **Run Command As** to indicate how the debug command is run: either as **a host path through a shared folder** or **a guest path**.

When **a host path through a shared folder** is selected, the folder where the command is located is shared before the debugging session is started. The command is executed from the shared folder, and when the debugging session ends, the folder is no longer shared. The name of the shared folder is `\\.host\Shared Folders\$(ProjectName)<random_number>`.

When **a guest path** is selected, the command is executed from the specified path on the guest.

The default is **a host path through a shared folder**.

4 Set **Remote Debug Monitor** to the location of the Remote Debug Monitor on the host.

The default is the Visual Studio installed path, typically:

```
\Program Files\Microsoft Visual Studio 8\Common7\IDE\Remote Debugger\x86\
              msvsmon.exe
```

Use the default remote debug monitor if you are debugging a 32-bit process in a 32-bit virtual machine.

If you want to debug a 32-bit process in a 64-bit virtual machine, use the Remote Debug Monitor:

```
\Program Files (x86)\Microsoft Visual Studio 8\Common7\IDE\Remote
              Debugger\x86\msvsmon.exe
```

If you want to debug a 64-bit process in a 64-bit virtual machine, use the 64-bit Remote Debug Monitor:

```
\Program Files\Microsoft Visual Studio 8\Common7\IDE\Remote
              Debugger\x64\msvsmon.exe
```

5 Type a name for the Remote Debug Monitor on the guest.

The default name is <user name>.

If a Remote Debug Monitor is already running on the guest, when the new connection is made between the Remote Debug Monitor on the guest and the Visual Studio debugger on the host, you are prompted to choose whether to connect to the one that is running or start another one with a different name.

Setting Virtual Machine Properties

Virtual machine properties include:

- The path to the virtual machine file (`.vmx` file).
- (Optional) The location of any directories shared between the host and the guest.

To set virtual machine properties

1 Choose **VMware>Options**, and select **Virtual Machine** in the left pane.

2 Set **Virtual Machine** to the path to the virtual machine file (`.vmx` file).

Click **Browse** to select from `.vmx` files on the system.

3 (Optional) Set **Shared Folders** to a semicolon-delimited list of paired folder names in the form <shared_name>=<host_folder_name>.

Click **Browse** to enter share names and folder names using a dialog box.

(Optional) Setting Pre-Debug Event Properties

Pre-Debug Event properties determine which actions are performed before the debug command is run. All of these settings are optional.

To configure actions to perform before beginning debugging

1 Choose **VMware>Options**, and select **Pre-Debug Event** in the left pane.

2 Set **Revert to Parent Snapshot** to **Yes** or **No**.

If set to **Yes**, the virtual machine reverts to its parent snapshot when the debugging session is started.

The default is **No**.

3 Set **Copy Files** to a semicolon-delimited list of paired file or directory names that are copied from the host to the guest machine in the form <host_machine_file/folder>=<virtual_machine_file/folder>.

Click **Browse** to select from files on the system.

All specified files are copied before any pre-debugging commands are executed.

4 Set **Command Line** to one or more semicolon-delimited commands that are run after files are copied (as described in the preceding step) and before the debugging session starts.

Click **Browse** to enter commands using a dialog box.

(Optional) Setting Post-Debug Event Properties

Post-Debug Event properties determine which actions are performed after the debug command is terminated. All of these settings are optional.

To configure actions to perform after debugging has occurred

1 Choose **VMware>Options**, and select **Post-Debug Event** in the left pane.

2 Set **Command Line** to one or more semicolon-delimited commands that are run after the debugging session ends.

Click **Browse** to enter commands using a dialog box.

3 Set **Termination Mode** to:

- No operation (default)
- Power off
- Revert to parent snapshot
- Suspend

Running and Debugging Applications in Virtual Machines

Once you have created the appropriate configurations, the Visual Studio Integrated Virtual Debugger enables you to:

- Start an application debugging session in a virtual machine.
- Start an application in a virtual machine without debugging.
- Start a debugging session that attaches to a process already running in a virtual machine.

Starting a Debugging Session in a Virtual Machine

You can debug an application in any configured virtual machine.

To start a debugging session in a virtual machine

1 Choose **VMware>Start**.

NOTE You must log in to the guest system manually before the application is started. For additional information, see "Configuring User Accounts" on page 429.

The application is started in the virtual machine.

2 Perform debugging tasks as you would from the **Debug>Start Debugging** Visual Studio menu.

If you want to kill the processes associated with the debugging session on the guest system and restart debugging, choose **VMware>Restart**.

Starting a Session Without Debugging in a Virtual Machine

You can start an application in any configured virtual machine without debugging.

When you start an application without debugging, the Visual Studio Integrated Virtual Debugger:

1 Powers on the virtual machine if necessary.

2 Shares the folder to the executable.

3 Runs the executable.

4 Removes the shared folder when the executable terminates.

When you start an application without debugging, the integrated virtual debugger does not execute pre-debug or post-debug operations, share additional directories, or start the Remote Debug Monitor on the guest system.

To start an application in a virtual machine without debugging

Choose **VMware>Start Without Debugging**.

NOTE You must log in to the guest system manually before you can run the application. For additional information, see "Configuring User Accounts" on page 429.

The application is started in the virtual machine.

Attaching the Debugger to a Process Running in a Virtual Machine

You can debug an application that is already running in a virtual machine.

To attach the debugger to a running process

1 Choose **VMware>Attach to Process**.

The Attach to Process page is displayed.

2 Choose the virtual machine on which to view running processes from the **Running Virtual Machines** drop-down menu.

Only virtual machines that are powered on appear in the drop-down menu.

3 Set **Remote Debug Monitor** to the location of the Remote Debug Monitor on the host.

The default is the Visual Studio installed path, typically:

```
\Program Files\Microsoft Visual Studio 8\Common7\IDE\Remote Debugger\x86\
              msvsmon.exe
```

Use the default remote debug monitor if you are debugging a 32-bit process in a 32-bit virtual machine.

If you want to debug a 32-bit process in a 64-bit virtual machine, use the Remote Debug Monitor:

```
\Program Files (x86)\Microsoft Visual Studio 8\Common7\IDE\Remote
              Debugger\x86\msvsmon.exe
```

If you want to debug a 64-bit process in a 64-bit virtual machine, use the 64-bit Remote Debug Monitor:

```
\Program Files\Microsoft Visual Studio 8\Common7\IDE\Remote
              Debugger\x64\msvsmon.exe
```

4 Type a name for the Remote Debug Monitor on the guest.

The default name is `VMDebug`.

NOTE If a Remote Debug Monitor is already running on the guest, you can start another one with a different name or use one that is already running.

5 Choose the process you want to attach to from the list of available processes, and click **Attach**.

If you want to refresh the list of running processes, click **Refresh**.

Glossary

A

administrative lockout
A global setting providing password protection for Windows hosts. Administrative lockout restricts users from creating new virtual machines, editing virtual machine configurations, and changing network settings.

B

bridged networking
A type of network connection between a virtual machine and the rest of the world. Under bridged networking, a virtual machine appears as an additional computer on the same physical Ethernet network as the host. *See also* host-only networking.

C

clone
A duplicate copy of a virtual machine. *See also* full clone, linked clone.

Clone Virtual Machine wizard
A point-and-click interface for convenient, easy duplication of a virtual machine within VMware Workstation. *See also* full clone, linked clone.

configuration
See virtual machine configuration file.

custom networking
Any type of network connection between virtual machines and the host that does not use the default bridged, host-only, or network address translation (NAT) networking configurations. For instance, different virtual machines can be connected to the host by separate networks or connected to each other and not to the host. Any network topology is possible.

D–E

disk mode

A property of a virtual disk that defines its external behavior (how the virtualization layer treats its data) but is completely invisible to the guest operating system. Available modes vary by product and include persistent mode (changes to the disk are always preserved across sessions), nonpersistent mode (changes are never preserved), undoable mode (changes are preserved at the user's discretion), and append mode (similar to undoable, but the changes are preserved until a system administrator deletes the redo-log file).

drag-and-drop

With the drag and drop feature of Workstation, you can move files easily between a Windows or Linux host and a Windows, Linux, or Solaris virtual machine. You can drag and drop individual files or entire directories.

F

Favorites list

A list in the left panel of the main Workstation screen that shows the names of virtual machines that a user has added to the list. The **Favorites** list makes it easy to launch a virtual machine or to connect to the virtual machine's configuration file in order to make changes in the virtual machine settings.

full clone

A complete copy of the original virtual machine plus all associated virtual disks. *See also* linked clone.

full screen mode

A display mode in which the virtual machine's display fills the entire screen. *See also* full screen switch mode.

full screen switch mode

A display mode in which the virtual machine's display fills the entire screen, and the user has no access to the VMware Workstation user interface. The user cannot create, reconfigure, or launch virtual machines. A system administrator performs these functions. *See also* full screen mode.

G

Go to Snapshot command

The **Go to Snapshot** command allows you to restore any snapshot of the active virtual machine. *See also* revert to snapshot.

guest operating system

An operating system that runs inside a virtual machine. *See also* "host operating system" on page 443.

H–K

headless
Describes a program that runs in the background without any interface connected to it. A running virtual machine that has no console connections is running headless.

host-only networking
A type of network connection between a virtual machine and the host. Under host-only networking, a virtual machine is connected to the host on a private network, which normally is not visible outside the host. Multiple virtual machines configured with host-only networking on the same host are on the same network. *See also* bridged networking, custom networking, network address translation (NAT).

host machine
The physical computer on which the VMware Workstation software is installed. It hosts the VMware Workstation virtual machines.

host operating system
An operating system that runs on the host machine. *See also* guest operating system.

independent disk
A type of virtual disk that is not affected by snapshots. You can configure independent disks in persistent and nonpersistent modes. *See also* nonpersistent mode, persistent mode, snapshot.

L–M

LAN segment
A private virtual network that is available only to virtual machines within the same team. *See also* virtual network, team.

linked clone
A copy of the original virtual machine that shares the virtual disks with the original virtual machine in an ongoing manner. *See also* full clone.

lockout
See administrative lockout.

N–O

network address translation (NAT)
A type of network connection that allows you to connect your virtual machines to an external network when you have only one IP network address, and that address is used by the host computer. If you use NAT, your virtual machine does not have its own IP address on the external network. Instead, a separate private network is

set up on the host computer. Your virtual machine gets an address on that network from the VMware virtual DHCP server. The VMware NAT device passes network data between one or more virtual machines and the external network. It identifies incoming data packets intended for each virtual machine and sends them to the correct destination.

New Virtual Machine wizard
A point-and-click interface for convenient, easy creation of a virtual machine configuration. It creates files that define the virtual machine, including a virtual machine configuration file and (optionally) a virtual disk or physical disk file. *See also* virtual machine settings editor.

NIC (network interface card)
An expansion board that provides a dedicated connection between a computer and a network. Also called a "network adapter."

nonpersistent mode
A disk mode in which all disk writes issued by software running inside a virtual machine appear to be written to the independent disk but are in fact discarded after the virtual machine is powered off. As a result, a virtual disk or physical disk in independent-nonpersistent mode is not modified by activity in the virtual machine. *See also* disk mode, persistent mode.

P

parent
The source or "original" virtual machine from which you take a snapshot or make a clone. A full clone has no continued link to its parent, but a linked clone and a snapshot each depend on the parent in an ongoing manner. If you delete the parent virtual machine, any linked clone or snapshot becomes permanently disabled. To prevent deletion, you can create a template virtual machine. *See also* full clone, linked clone, snapshot, template.

persistent mode
A disk mode in which all disk writes issued by software running inside a virtual machine are immediately and permanently written to a virtual disk that has been configured as an independent disk. As a result, a virtual disk or physical disk in independent-persistent mode behaves like a conventional disk drive on a physical computer. *See also* disk mode, nonpersistent mode.

physical disk
A hard disk in a virtual machine that is mapped to a physical disk drive or a partition of a drive on the host machine. A physical disk is also referred to as a raw disk. A virtual machine's disk can be stored as a file on the host file system or on a

local hard disk. When a virtual machine is configured to use a physical disk, VMware Workstation directly accesses the local disk or partition as a physical device (not as a file on a file system). It is possible to boot a previously installed operating system on an existing partition within a virtual machine environment. The only limitation is that the existing partition must reside on a local IDE or SCSI drive. *See also* virtual disk.

Q

quick switch mode

A display mode in which the virtual machine's display fills most of the screen. In this mode, tabs at the top of the screen allow you to switch quickly from one running virtual machine to another. *See also* full screen mode.

R

raw disk

See physical disk.

record/replay feature

This feature lets you record all of a Workstation 5 or 6 virtual machine's activity over a period of time. Unlike Workstation's movie-capture feature, the record/replay feature lets you exactly duplicate the operations and state of the virtual machine throughout the time of the recording.

redo log

The file that stores changes made to a disk in all modes except the persistent and independent-persistent modes. For a disk in nonpersistent mode, the redo-log file is deleted when you power off or reset the virtual machine without writing any changes to the disk. You can permanently apply the changes saved in the redo log to a disk in undoable mode so that they become part of the main disk files. *See also* disk mode.

resume

Return a virtual machine to operation from its suspended state. When you resume a suspended virtual machine, all applications are in the same state they were when the virtual machine was suspended. *See also* suspend.

revert to snapshot

Reverting to a snapshot restores the status of the active virtual machine to its immediate parent snapshot. This parent is represented in the snapshot manager by the snapshot appearing to the immediate left of the **You Are Here** icon. *See also* Go to Snapshot command, snapshot manager, You Are Here (icon).

S

shared folder

A shared folder is a folder on the host computer—or on a network drive accessible from the host computer—that can be used by both the host computer and one or more virtual machines. It provides a simple way of sharing files between host and guest or among virtual machines. In a Windows virtual machine, shared folders appear as folders on a designated drive letter. In a Linux or Solaris virtual machine, shared folders appear under a specified mount point.

snapshot

A snapshot preserves the virtual machine just as it was when you took that snapshot. This includes whether the virtual machine was powered on, powered off, or suspended. If the virtual hard disks are not set to independent mode, a snapshot also includes the state of the data on all the virtual machine's disks. Workstation lets you take snapshots of a virtual machine at any time and revert to that snapshot at any time. You can take a snapshot when a virtual machine is powered on, powered off, or suspended. *See also* independent disk.

snapshot manager

The snapshot manager is a window that allows you to take actions on any of the snapshots and recordings associated with the selected virtual machine. *See also* record/replay feature, snapshot.

suspend

Saves the current state of a running virtual machine. To return a suspended virtual machine to operation, you use the resume feature. *See also* resume.

T–U

team

A group of virtual machines that are configured to operate as one object. You can power on, power off, and suspend a team with one command. You can configure a team to communicate independently of any other virtual or real network by setting up a LAN segment. *See also* LAN segment, virtual network.

template

A virtual machine that cannot be deleted or added to a team. Setting a virtual machine as a template protects any linked clone or snapshots from being disabled inadvertently. *See also* linked clone, parent, snapshot.

undoable mode

In VMware ESX Server 2.x, a disk mode in which all write operations issued by software running inside the virtual machines appear to be written to the disk but are in fact stored in a temporary file (`.REDO`) for the duration of the session. When the virtual machine is powered off, the user has three choices: permanently apply

all changes to the disk; discard the changes, thus restoring the disk to its previous state; or keep the changes, so that further changes from future sessions can be added to the log. *See also* disk mode.

V–X

virtual disk
A file or set of files appearing as a physical disk drive to a guest operating system. These files can be on the host machine or on a remote file system. When you configure a virtual machine with a virtual disk, you can install a new operating system into the disk file without the need to repartition a physical disk or reboot the host. *See also* physical disk.

virtual hardware
The devices that make up a virtual machine. The virtual hardware includes the virtual disk, removable devices such as the DVD-ROM/CD-ROM and floppy drives, and the virtual Ethernet adapter. You configure these devices with the virtual machine settings editor. *See also* virtual machine settings editor.

virtual machine
A virtualized x86-compatible PC environment in which a guest operating system and associated application software can run. Multiple virtual machines can operate on the same host machine concurrently.

virtual machine configuration
The specification of what virtual devices (disks, memory size, etc.) are present in a virtual machine and how they are mapped to host files and devices.

virtual machine configuration file
A file containing a virtual machine configuration. It is created by the New Virtual Machine wizard. It is used by VMware Workstation to identify and run a specific virtual machine.

virtual machine settings editor
A point-and-click editor used to view and modify the settings of a virtual machine after its initial creation. *See also* New Virtual Machine wizard.

virtual network
A network between virtual machines with no dependence on real-world hardware connections. For example, you can create a virtual network between a virtual machine and a host that has no external network connections. You can also create a LAN segment for communications between virtual machines on a team. *See also* LAN segment, team.

virtual network editor

A point-and-click editor used to view and modify the networking settings for the virtual networks created by VMware Workstation.

VMware Player

Free software that enables PC users to easily run any virtual machine on a Windows or Linux PC. VMware Player runs virtual machines created by VMware Workstation, VMware Server, or ESX Server and also supports Microsoft virtual machines and Symantec Backup Exec System Recovery disk formats.

VMware Tools

A suite of utilities and drivers that enhances the performance and functionality of your guest operating system. Key features of VMware Tools include some or all of the following, depending on your guest operating system: an SVGA driver, a mouse driver, the VMware Tools control panel and support for such features as shared folders, drag-and-drop, shrinking virtual disks, time synchronization with the host, VMware Tools scripts, and connecting and disconnecting devices while the virtual machine is running. *See also* drag-and-drop, shared folder.

Y–Z

You Are Here (icon)

A special icon appearing in the snapshot manager that indicates the current status of the active virtual machine. This can be important when deciding whether to revert to, or go to a snapshot. *See also* snapshot manager, revert to snapshot, Go to Snapshot command.

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